3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

The National Environment Policy Act of 1969 (NEPA) requires that an Environmental Impact Statement be written for a proposed federal project or a federally funded project which would affect the human environment. The Environmental Impact Statement is to be developed using the guidelines established by the Council on Environmental Quality (CEQ). Public scoping and agency consultation processes must adhere to CEQ's guidelines. For the proposed Milltown Hill Project, these processes have been on-going for over 3 decades. During these processes, especially during the past 3 years, potential problems have been identified which required the need for ancillary studies, to provide information for evaluation of impacts of project construction and operation. These studies were conducted and are reported in various Technical Appendices and special reports (See: Table 4-1 Section 4, Consultation and Coordination).

This EIS addresses each known environmental component which could be affected by the project. The existing conditions, impacts, and mitigative and enhancement measures for most components are addressed commensurate with the level of concern identified during the public scoping process, agency consultation process, and in subsequent studies. When additional concerns were identified during impact evaluation they were treated commensurate with the magnitude of impact expected. The main concerns of the agencies and the public were the adverse impacts of reservoir inundation and the favorable impacts of the predicted change of Elk Creek water regime on the existing biological environmental components.

Consequences of constructing and operating the proposed project will be quantified, whenever possible, in terms of incidence, intensity, magnitude and duration. Mitigation measures to offset adverse impacts will also be quantified in terms of effectiveness when possible. Enhancement measures will be addressed separately. Based on the level of impact expected on various environmental resources, environmental commitments are proposed to ameliorate or avoid impacts (Appendix B).

3.1 Preferred Alternative

This EIS addresses construction impacts and operation impacts separately, as appropriate. Construction activities would be localized and would occur primarily in and near the reservoir pool area during a 3-year period.

The relative proximity and timing of construction activities and the similarity of impacts expected allows an analysis of impacts by grouping all activities under "construction impacts" for each environmental component.

Construction activities in the reservoir area include:

- Constructing the service road (Dark Canyon Road) from County Road #7 to the base of the dam
- Constructing the haul road in the reservoir area
- Preparing the Otten Quarry for extraction of rock material
- Operating a rock crusher in the staging area and in the contractor work area for aggregate sizing
- Operating a batch plant for roller compacted concrete processing in the staging area
- Constructing and using 2 or 3 settling ponds (1/4 to 1 acre each) in the work area for cleaning fines from crushed aggregate
- Stockpiling and mixing aggregate in the contractor work area or in the staging area
- Constructing the dam and appurtenances
- Removing overburden from the dam abutments and hauling to the eastern recreation site
- Setting of 2 coffer dams and a diversion in Elk Creek at the damsite and across Elk Creek near Otten Quarry
- Clearing of timber in the main pool area
- Recontouring of the eastern recreation site
- Relocating portions of County Roads #7 and #8
- Constructing two causeways on County Road #8 across the reservoir
- Constructing the transmission tower island and excavating wetlands south of the causeway
- Placing the buried pipeline and electrical transmission line in the road right-of-way of Dark Canyon Road
- Constructing the recreational facilities
- Constructing the microwave tower and facilities

Construction activities are scheduled as shown in Figure 2-8.

Construction activities away from the pool area would involve the installation of an irrigation pipeline network in the service areas.

An Annual reservoir operation schedule is shown in Figure 2-8. Operation of the project would cause impacts in the reservoir pool area, but the majority of potential impacts during operation would occur in Elk Creek downstream of the dam. These impacts will be discussed under "operation impacts" for each environmental component.

3.1.1 Topography

3.1.1.1 Existing Topography

Elk Creek, in the northern portion of Douglas County, Oregon, is a subbasin of the Umpqua River Basin. Elk Creek flows from east to west, extends about 45 miles from its source in the foothills of the Cascade mountain range to its confluence with the Umpqua River near Elkton, and is about 290 square miles in area. Elevation ranges from 150 feet to 2600 feet. Topography is generally mountainous, with rounded slopes, incised by steep, narrow canyons. Topographic relief is more pronounced in the higher eastern part of the subbasin, which exhibits well dissected topography with narrow, steep-walked valleys in a deeply entrenched dendritic pattern. Topographic relief in the western portion of the subbasin is less pronounced.

The watershed for the reservoir heads at the Calapooya Divide about 7 to 8 miles upstream from the damsite (river mile 39.4) with the divide trending both east and south of the reservoir area. Water drains from Dickinson Mountain trending along the west side of the reservoir and from the east and north from the north trending ridge between Harness Mountain and Hobart Butte. Tributaries to Elk Creek above the dam are Shingle Mill, Walker and Lane Creeks. The total watershed of the dam is approximately 30.5 square miles, with elevations ranging from 600 feet at the damsite to approximately 2600 feet in the higher ridges along the southern subbasin boundary. The reservoir created by the Milltown Hill Dam would inundate 681 acres at normal full pool elevation of 775 feet.

3.1.1.2 Topography Impacts

3.1.1.2.1 Construction

The topography would be altered from a vegetated meandering broad valley by construction of the 186 foot-high dam, and a resulting 681-acre reservoir. Major topographic changes would result from overburden removal for preparation of the dam and rock extraction from the Otten Quarry. Relatively minor changes in topography would result from relocated roads, causeways, recreation sites, and the transmission line island in the south end of the reservoir.

3.1.1.2.2 Operation

The operation of the reservoir would result in a change in topography, depending on season. During reservoir drawdown, the present vegetated area would be replaced by mud flats in the south end of the reservoir. This would occur during the irrigation season (April 1 to October 30). Reservoir level would decrease until winter rains begin to occur (approximately November). The reservoir would continue to fill until sometime in the spring, when the rainy season ends. The annual drawdown of the reservoir would, therefore indirectly affect the area's visual quality and recreational use (See: Sections 3.1.17.2 Recreation and 3.1.19.2 Visual Resources).

3.1.1.3 Mitigation of Topography Impacts

Topographic impacts cannot be fully mitigated. A stream valley setting would be exchanged for a reservoir setting. Cuts and fills required for road relocation would be minimized as possible during final design. The topographic impacts caused by the new roads would not be significantly different from present conditions. Cuts and fills on relocated and new roads would be sloped to prevent landslides and would be revegetated to decrease erosion. The recreation areas would be constructed to fit with present topographic features and landscaped with native plants. The island needed for powerline transmission towers would be contoured and landscaped to fit topographic features.

3.1.2 Geology and Seismicity

3.1.2.1 Existing Conditions

The oldest geologic formations in and surrounding the project area are of relatively recent origin, dating to the early Tertiary Period (70 million years before present), when the Cascadian mountain-making epoch began (Table 3-2-1). Rocks in the project area are mostly Tertiary volcanics and sediments. The oldest rocks are of the Umpqua formation, up to 12,000 feet thick, formed in the early Eocene epoch.

Table 3-2-1. Geologic Time Chart to 70 Million Years Before Present.

ERA	PERIODS	EPOCHS	ROCK FORMATIONS
Cenozoic	Quaternary	Holocene (Recent)	Alluviums and Landslide Debris
		Pleistocene (Glacial)	Unconsolidated Alluvium Landslide Debris
	Tertiary	Pliocene (Modern Plants and Animals Developed)	
		Miocene (Development of Large Mountain Ranges	
		Oligocene (Development of higher mammals)	Fisher (Pyroclastics, Volcanics) Spencer (Sandstones, Siltstones)
		Eocene (Mammals Became Dominant Animals)	Tyee (Sandstones, Siltstones) Umpqua (Volcanics)
		Paleocene	

The Tyee Formation, of the middle Eocene epoch, overlies the Umpqua formation in sandstone and siltstone beds up to 30 feet thick. Later, in the late Eocene epoch, to the middle Oligocene epoch, the Spencer formation, comprised mostly of sandstone and siltstone, overlaid the Tyee formation.

Above the Spencer formation is the Fisher formation, up to 5,000 feet thick, consisting of pyroclastic and volcanic rocks, which formed the western Cascade Range, during the middle Oligocene epoch. The above formations are interspersed with dikes of the most recent Miocene age (Bureau of Mines, 1990). Unconsolidated Quaternary deposits include Pleistocene alluvium on terraces along the Umpqua River, and Pleistocene and recent landslide debris in the river's tributaries. The area contains three parallel, northeast-trending anticlines, doubly plunging northeast and southwest (Figure 3-2-1). Basalt flows of the Umpqua formation are exposed in the center of these anticlines. The dam site is near the axis of the northeast-trending Red Hill anticline which is broken by northwest-trending normal faults and northeast trending reverse faults (Figure 3-2-1). (Bureau of Mines, 1990; Geological Survey, 1963).

Seismicity in western Oregon is sparse, poorly located, and poorly understood. The largest historical event in the region occurred offshore of the Oregon - California border in 1873 and was estimated with an intensity magnitude of 7. The area near the Milltown Hill site is notable for its lack of seismicity (Bureau of Reclamation, 1990).

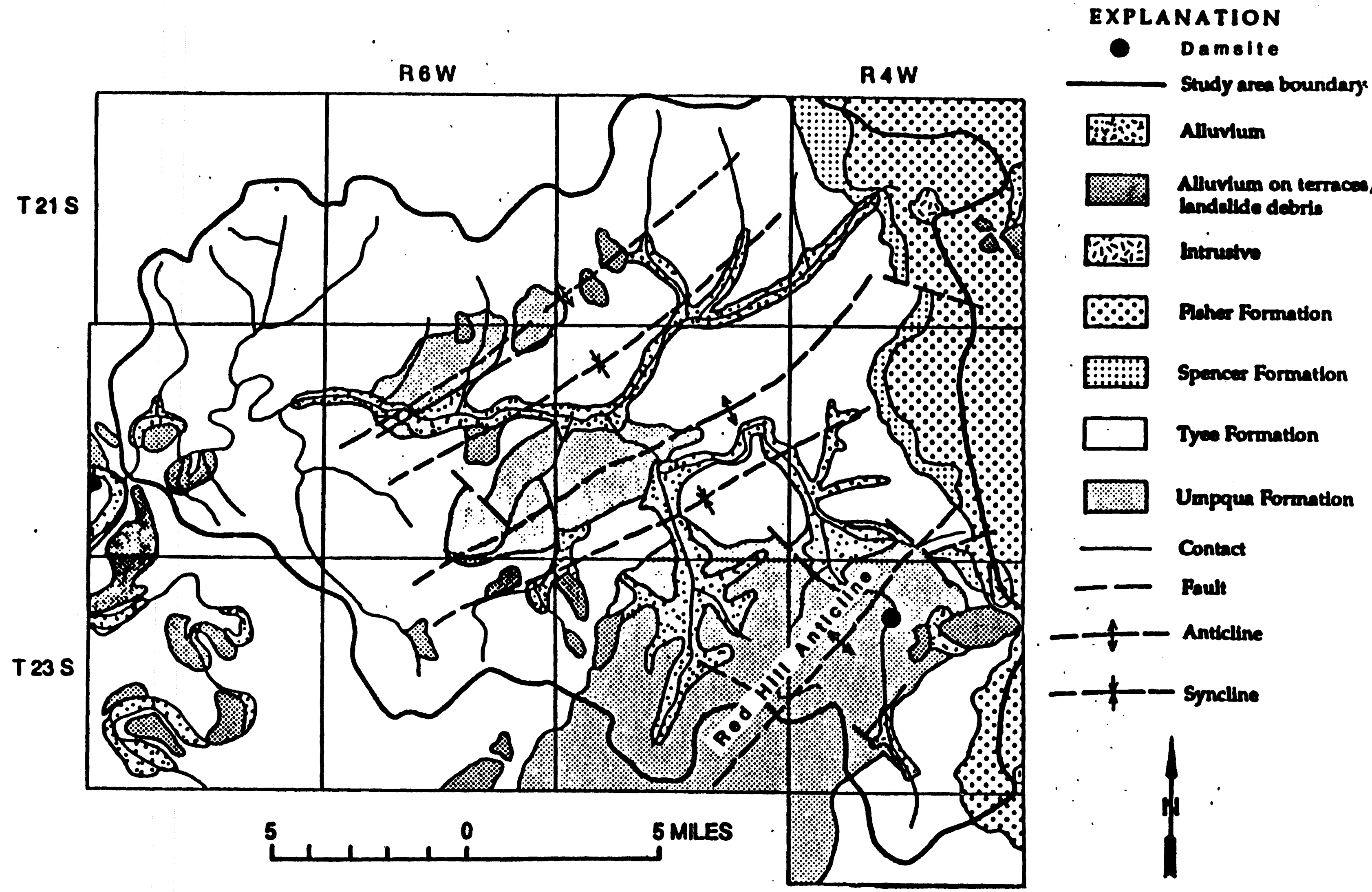


Figure 3-2-1. Geology of the project area. (modified from U.S. Bureau of Mines, 1990)

Douglas County is situated at the western edge of the North American plate along the Cascadia subduction zone, where active subduction of the Juan de Fuca plate beneath the North American plate is occurring. The coast range province has experienced a very low level of historical seismicity and is not known to contain any active faults.

The average seismic energy release in the coast range for the 100-year period from 1870 to 1970 is approximately equivalent to one magnitude 5.0 earthquake each decade. Observations at the Corvallis, Oregon seismograph station indicate continuing minor seismic activity in the coast range area between Drain and Reedsport on the coast.

Analysis of these events, area geology, and geological investigations at the Milltown Hill damsite resulted in the determination of a maximum credible earthquake of a magnitude 6.25. Structures designed for this site should be capable of withstanding this maximum credible earthquake (Bureau of Reclamation, 1990).

3.1.2.2 Impacts of Geology and Seismicity

Historically, Oregon has not experienced earthquakes which would have caused significant damage to a dam constructed at the Milltown Hill site. Strong earthquakes which could occur off the coast of Oregon or California would be too distant from the project site to be considered potentially seismic hazardous. A broad seismic zone map of the United States developed by the Corps of Engineers indicates the proposed project is located in seismic zone 1 (minor damage), which is assigned a seismic coefficient of 0.025g.

Reservoir-induced seismicity is not a potential hazard. The proposed reservoir is too small and shallow to be a likely cause of induced earthquakes. Furthermore, the local geologic conditions and lack of seismicity in the area suggests that reservoir-induced seismicity does not warrant engineering considerations for this site. The lack of potentially active faults in the reservoir subbasin suggests that an earthquake-induced wave on the reservoir is not a design consideration (Bureau of Reclamation, 1990). The dam has been designed to withstand the maximum anticipated earthquake for the area.

3.1.2.3 Mitigation of Geologic Hazards and Seismic Conditions

Plans and specifications of the Milltown Hill dam would be reviewed by a qualified Board of Consultants, to assure that the project is designed according to accommodate any known geologic hazard or anticipated seismic conditions. Construction supervision would be provided by competent engineering staff. A resident engineer and appropriate inspectors, technicians and support personnel would continuously monitor construction quality. The County would prepare detailed operation and maintenance plans.

3.1.3 Soils and Land Classification

3.1.3.1 Existing Soils and Land Classification

The soils of the Elk Creek subbasin area may be categorized into three main groups: recent alluvial, old alluvial and residual (Bureau of Reclamation, 1991).

- Recent alluvial soils are generally the most productive within the subbasin. They are located on low terraces bordering streams. These soils are characterized by little or no profile development. They are generally medium textured, deep and well drained.

- Old alluvial soils are more extensive. They are located between the recent alluvial soils on low terraces and the residual soils on footslopes and hillsides. These soils are characterized by fine textured subsoils with moderately slow to slow permeability. Some small areas of hydric soils are associated with this group. Vegetation in these hydric soils is predominantly sedges and rushes.

- Residual soils are the most extensive in the subbasin, but are less important than the alluvial soils because they are comparatively shallow over bedrock. Also, they occur on the more sloping lands in the subbasin. These soils developed in place from materials derived from both igneous and sedimentary rocks. Depth to bedrock is highly variable over short distances.

All soils in the subbasin are free of harmful levels of salinity and sodicity. Organic matter content is relatively high, and soil pH is neutral to slightly acid.

Land classifications were made to segregate arable land from nonarable land and to divide the arable lands into economic classifications in which the physical differences in land reflect dollar differences in net farm income. A review of previous work covering more than 15,000 acres combined with specific site analyses and laboratory tests resulted in the land class specifications presented in Table 3-3-1.

The arable area comprises all land delineated in the land classification that could provide sufficient income to warrant

Table 3-3-1. Summary of Arable Land Class Classifications.

Class 1	Class 2	Class 3	Class 4P
Soil Characteristics			
Sandy loam through clay loam except as noted below.	Loamy sand to permeable clay.	Loamy sand through permeable clay.	Same as Class 3.
Sand permitted below 36 inches with available water holding capacity of 6 inches or more in upper 48 inches.	Loamy coarse sand or sand permitted below 24 inches with available water holding capacity of 4.5 inches or more in upper 48 inches.	Loamy coarse sand or sand permitted below 12 inches with available water holding capacity of 3 inches in the upper 48 inches.	No sand, loamy sands or sandy loams permitted.
No clay, silty clay, or sandy clay in upper 30 inches.	Permeable clay permitted below 12 inches.	Entire profile may be permeable clay if infiltration rate is adequate for plant moisture requirements.	Same as Class 3.
5 feet or more to impermeable material.	4 feet or more to impermeable material.	3 feet or more to impermeable material.	1.5 feet or more to impermeable material.
Sodium Absorption Ratio should be less than 10 in fine (clay) textured soils but may range to 20 in coarse textured soils with adequate drainage.	Same as Class 1.	Same as Class 1.	Same as Class 1.
Equilibrium salinity less than 4 milliohms per centimeter with adequate drainage.	Equilibrium salinity less than 5 milliohms per centimeter with adequate drainage.	Equilibrium salinity less than 8 milliohms per centimeter with adequate drainage.	Same as Class 3.
Topographic Characteristics			
General gradient not to exceed 6 percent but may include small escarpments or other topographic features which exceed this slope limitation when land considerations would dictate their inclusion.	General gradient not to exceed 12 percent but may include small escarpments or other topographic features which exceed this slope limitation when land considerations would dictate their inclusion.	Same as Class 2. exceed 20 percent.	General gradient not to exceed 20 percent
Minimum size of 8 acres. Width of field generally is more than 400 feet.	Minimum size of 5 acres. Width of field generally is more than 300 feet.	Minimum size of 2 acres. Width of field generally is more than 200 feet.	Same as Class 3.
May spend up to $233 per acre to make land tillable and suitable for movement of sprinkler system.	May spend up to $467 per acre to make land tillable and suitable for movement of sprinkler system.	May spend up to $700 per acre to make land tillable and suitable for movement of sprinkler system.	No Development Costs
Cover can be removed with $233 or less per acre.	Cover can be removed with $467 or less per acre.	Cover can be removed with $700 or less per acre.	No Development Costs
Drainage Characteristics			
Surface drainage can be provided with $233 or less per acre. Surface outlet excavation needed.	Surface drainage can be provided with $467 or less per acre. Surface outlet excavation needed.	Surface drainage can be provided with $700 or less per acre. Surface outlet excavation needed.	No Development Costs
Permissible Development Costs			
Development cost of $233 or less per acre.	Development cost of $467 or less per acre.	Development cost of $700 or less per acre.	No Development Costs

Major surface outlets for each farm over $375 per acre and all subsurface drainage will be provided as a project cost. Lands potentially arable, but nondrainable within cost limitations, will be designated 6D.

Source: Bureau of Reclamation, 1991.

consideration for irrigation development. In general, arable land is land which, when irrigated, has the capacity to generate sufficient income to cover all farm production expenses and still provide a reasonable family income. Certain conditions are crucial:

- Farms must be of adequate size considering climate and economic setting.
- Farms must be provided with the essential on-farm improvements. Examples could be removing vegetation and other cover, leveling, soil reclamation, drainage, and irrigation-related facilities.

The land classification process identified approximately 7,377 acres of arable land as shown in Table 3-3-2. The distribution of these lands is shown on Figure 3-3-1.

Table 3-3-2. Arable Lands (Acres).

Location	Class 1	Class 2	Class 3	Class 4P	Total
Lower Elk Creek	422	303	231	775	1,731
Upper Elk Creek	230	347	123	185	885
Yoncalla Valley	69	529	1,490	1,213	3,301
Scotts Valley	125	429	516	390	1,460
Totals	846	1,608	2,360	2,563	7,377

Lower Elk Creek is Drain to Elkton.
Upper Elk Creek is upstream of Drain to Interstate 5.

Source: Bureau of Reclamation, 1991.

Nonarable land is usually represented as class 6 land. Any deficiency that would increase costs of production to where a farm could not provide a reasonable income is considered nonarable. Nonarable lands not measured or tabulated in the land classification survey included creeks and adjacent riparian areas, steeply sloping wooded hillsides, roads and highways, and residential areas. The only nonarable land that was delineated and measured was classed as "6sd;" signifying wetlands with emergent aquatic vegetation. (See: Section 3.1.11, Vegetation).

The primary problem regarding the suitability of area lands for sustained irrigation is restricted subsurface water movement and inadequate natural drain channels. Heavy winter and spring rainfall aggravates the drainage problems and delays farm operations that involve tillable crops. Some farmers have installed shallow tile drains to relieve the water table after the spring rains to allow earlier tilling of the soil. The high water table is a lesser concern for hay, grass, and livestock operations. With the added irrigation component during the dry summer months

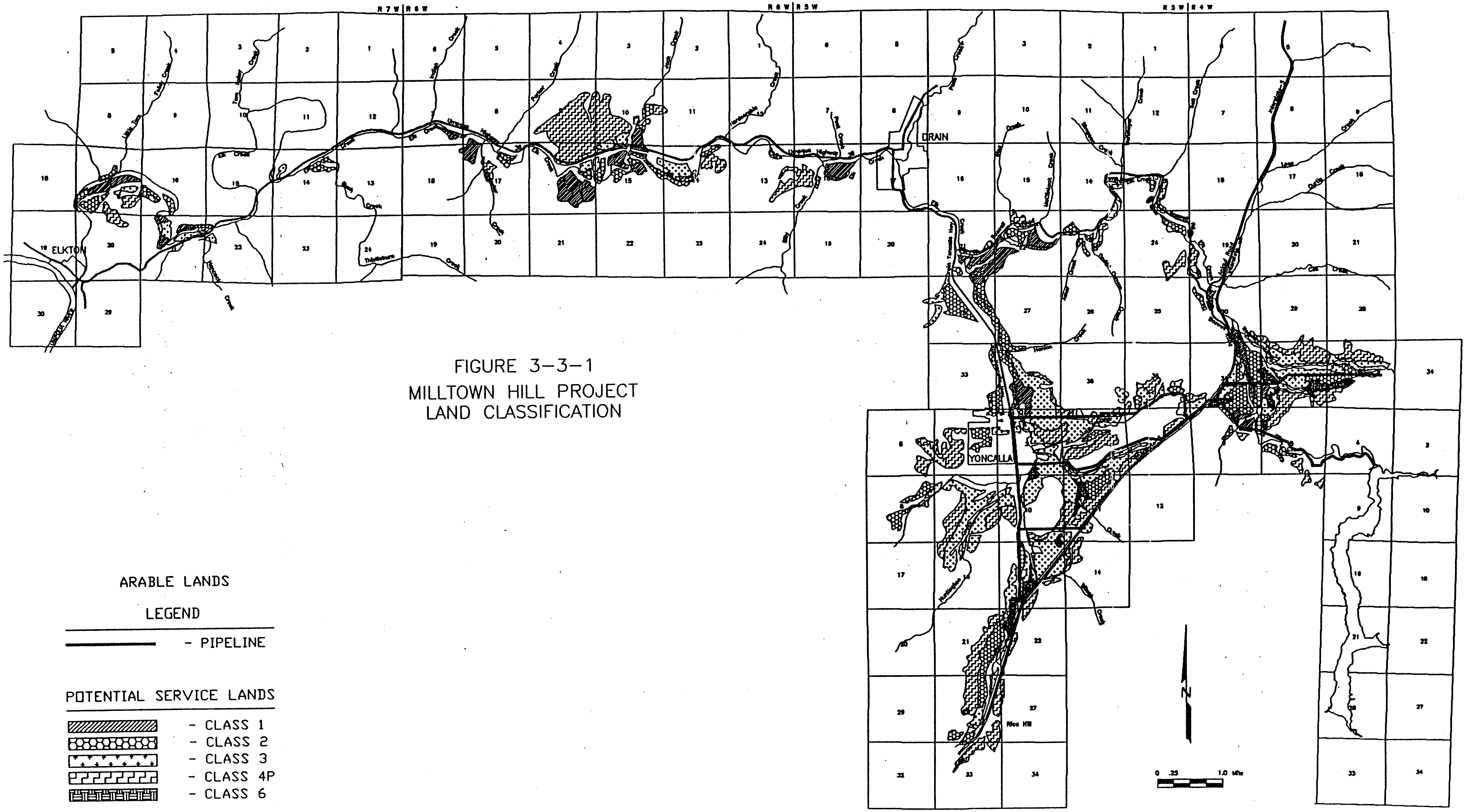


FIGURE 3-3-1
MILLTOWN HILL PROJECT
LAND CLASSIFICATION

(which are normal drain out periods), the high water table conditions during the spring would increase, and drainage problems would be intensified and enlarged. Those lands that may require drainage facilities are shown on Figures 3-3-2 and 3-3-3. Drainage would not affect wetlands.

Hydraulic conductivity tests were conducted in the Scotts Valley and Yoncalla Valley areas and in some of the parcels along Elk Creek that require supplemental irrigation. The resulting hydraulic conductivity rates used for drain spacing calculations are noted below.

- Lower Elk Creek from Drain to Elkton -- 3.6 inches per hour (in/hr).
- Upper Elk Creek from Drain to Interstate Highway 5 along Elk Creek, and from the intersection of Elk and Yoncalla Creeks 1 1/2 miles south to the confluence of Hanlon Creek -- 1.0 in/hr.
- Yoncalla Valley -- 1.2 in/hr.
- Scotts Valley -- 2.20 in/hr.

The estimated acres for each area where subsurface drainage would be required and field cost per acre for drains in each area are shown in Table 3-3-3. Subsurface interceptor drains are also included in the cost estimates. These drains are intended for use in small, narrow tracts of land which lie below irrigated lands that are steeper and which tend to provide runoff and seepage to the areas below.

A significant amount of land classified as arable also has been mapped by the Soil Conservation Service (SCS) as having hydric soils. The SCS mapping is in conjunction with its responsibility for determining wetlands in irrigated areas, however wetlands would not be drained.

The irrigation suitability land classification included a screening procedure for trace elements and other potentially toxic constituents. Some of the elements of concern were determined from Federal Primary and Secondary Drinking Water Standards and EPA priority pollutants. Other elements considered to be relatively nontoxic to humans or animals were included because of potential corrosion, discoloration, or esthetic concerns. The results of these tests indicated that all constituents were within the range of baseline levels typical for the western United States.

increased noise levels. Typically, the sounds of chainsaws and logging equipment during reservoir clearing, earthmovers, bulldozers, dump trucks, wagon drills during excavations at the damsite and at the Otten Quarry, punctured by occasional blasting, can be expected during the 3 year construction period. Increased road traffic and accompanying higher sound levels would be experienced by residents living near County roads #7 and #8. Most of the increased noise levels would not exceed 90-95 dBA, and would occur during daylight hours only.

The construction of the pipeline in the service area would result in some minor, short-term increase in noise levels during daylight hours.

3.1.7.2.2 Operation

Motorboating would be the greatest noise source during operation of the project. Boating would be concentrated in the center pool area, since a barrier would be placed across the narrower neck of the pool at the upper end. Boat access would not be permitted in the wildlife area.

3.1.7.3 Mitigation of Noise Impacts

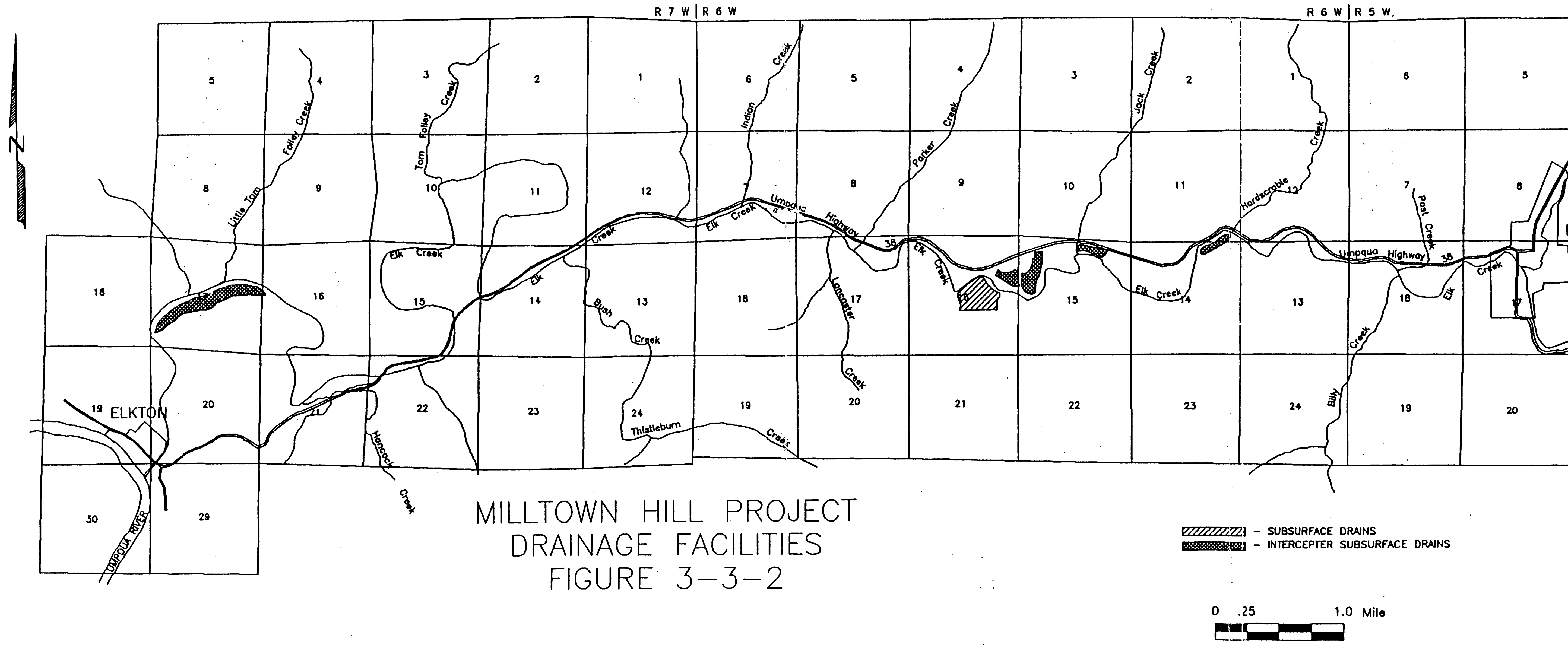
Construction specification would require the contractor to comply with the Noise Control Act of 1972 (Public Law 92-574) as amended by the Quiet Communities Act of 1978 (H.R.12647). Boating noise impacts would be minimal because not many people would be living near the reservoir.

3.1.8 Surface Water Quantity

3.1.8.1 Existing Surface Water Quantity

Surface water flows in Elk Creek subbasin are unregulated except during the irrigation season, when minimum flows (the 1974 minimum flows were converted to instream water rights in 1989) are enforced. Low elevations and mild winters result in little snowfall, but abundant rainfall occurs during the winter and spring months. The pattern of stream flow follows the precipitation pattern with high flows in winter and spring and very low flows in summer (Douglas County Water Resources Survey, 1990).

Recorded flow extremes at the Elk Creek gage near Drain, range from a minimum daily flow of 0.0 cubic feet per second (cfs) to a maximum instantaneous flow of 19,000 cfs. This peak flow occurred on February 10, 1961. Summer flows at the gage fall below 10 cfs frequently. The mean annual flow for the period of record (1956-



MILLTOWN HILL PROJECT
DRAINAGE FACILITIES
FIGURE 3-3-2

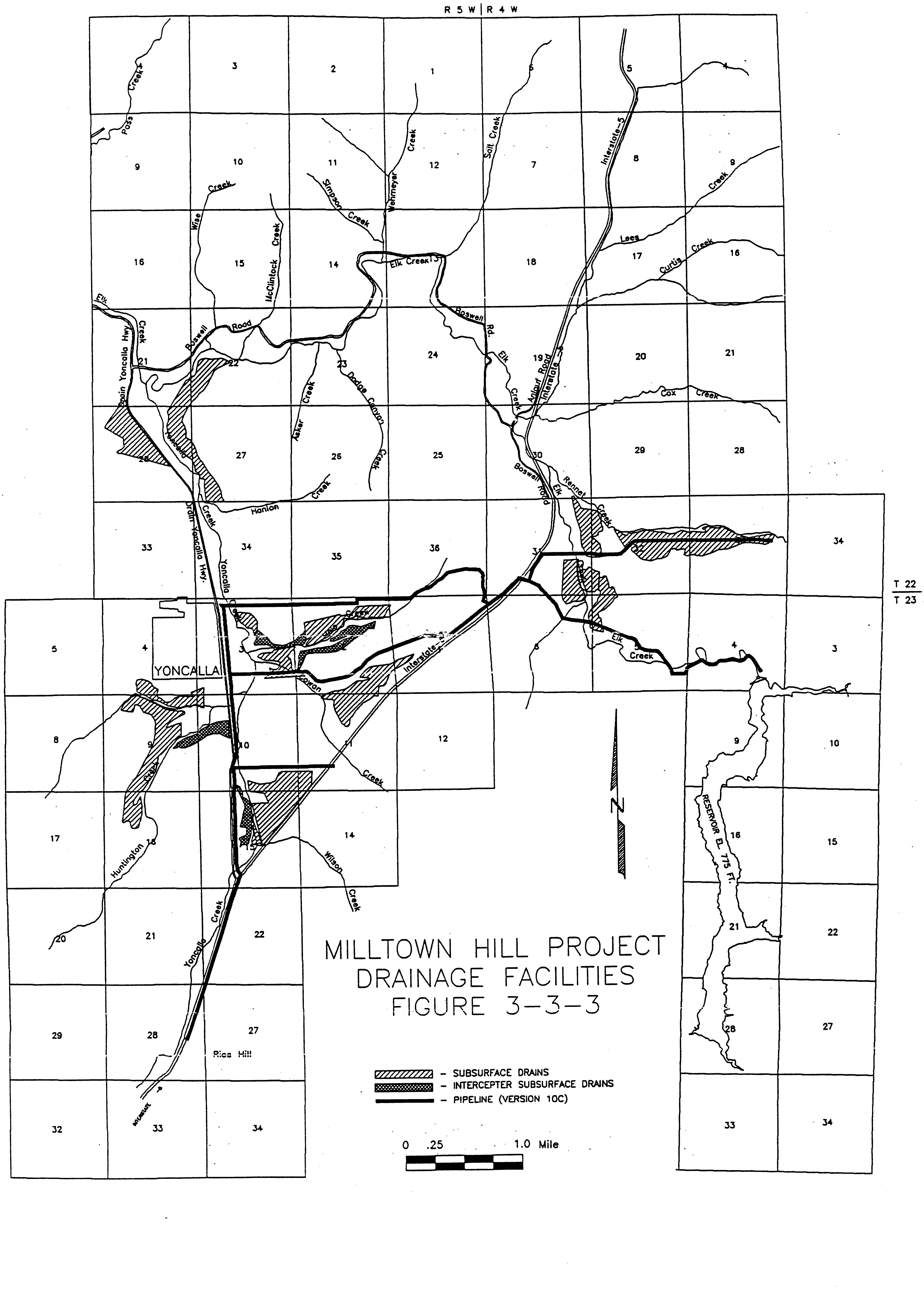

R 5 W | R 4 W
T 22
T 23
Poss Creek
Wise Creek
McClintock Creek
Simpson Creek
Wehmeyer Creek
Salt Creek
Interstate-5
Lees
Curtis Creek
Elk Creek
Boswell Road
Boswell Rd.
Drain Yoncalla Hwy
Dodge Canyon Creek
Asker Creek
Anlauf Road
Cox Creek
Rennet Creek
Hanlon Creek
Yoncalla Creek
YONCALLA
Cowan
Huntington
Wilson Creek
Rice Hill
RESERVOIR EL. 775 FT.
N
MILLTOWN HILL PROJECT
DRAINAGE FACILITIES
FIGURE 3-3-3
- SUBSURFACE DRAINS
- INTERCEPTER SUBSURFACE DRAINS
- PIPELINE (VERSION 10C)
0 .25 1.0 Mile

Table 3-3-3. Summary of Estimated Drainage Costs Per Acre.

Service Area	Area drained (acres)	Drain spacing (feet)	Length of Pipe Req'd (feet/acre)	Subsurface Drain ($/acre)	Outlet Drains ($/acre)	Total field cost ($/acre)
Scotts Valley						
w/ Outlet Drains	85	235	185	370	75	445
w/o Outlet Drains	343	235	185	370	-	370
Subtotal	428					
Yoncalla						
w/Outlet Drains	128	165	264	525	75	600
w/o Outlet Drains	506	165	264	525	-	525
Interceptor Drain	114			300	-	300
Subtotal	748					
Lower Elk Creek						
w/ Outlet Drain		425	102	205	75	280
w/o Outlet Drain	42	425		205	-	205
Interceptor Drain	103			300		300
Subtotal	145					
Upper Elk Creek						
w/ Outlet Drain	248	225	194	390	75	465
w/o Outlet Drain				390	-	390
Total	1,569					

Source: Bureau of Reclamation, 1991.

In compliance with the Farmland Protection Act, Public Law 97-99, the SCS was contacted to identify lands classified as prime and unique farmlands. As a result the SCS conducted a survey of the area within the reservoir take-line and the irrigation service areas for prime and unique farmlands. Prime and unique farmlands are defined as follows:

Prime farmland - land that has the best combination of physical and chemical properties for producing sustained high yields of crops when treated and managed according to acceptable farming methods. Approximately 115 acres of prime farmland were found in the reservoir area (Figure 3-3-4). No prime farmlands were found in the service areas.

Unique farmland - land other than prime farmland that could be used for the production of specific high value, high yield food and fiber crops, such as citrus, tree nuts, cranberries, fruit, and vegetables. No unique farmlands were found in either the reservoir area or the service areas.

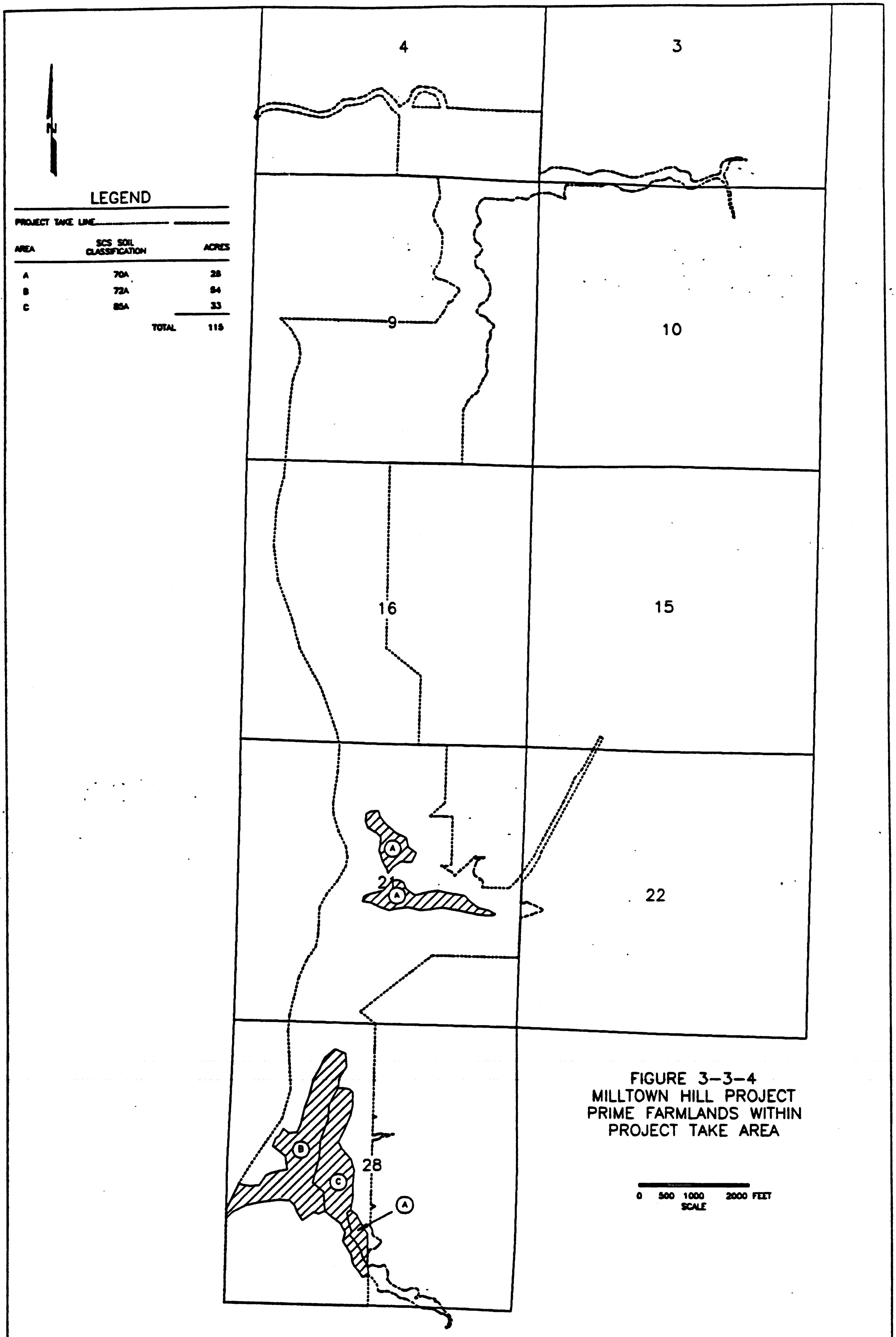


FIGURE 3-3-4
MILLTOWN HILL PROJECT
PRIME FARMLANDS WITHIN
PROJECT TAKE AREA

3.1.3.2 Impacts to Soils and Land

3.1.3.2.1 Construction

Impacts to soils would occur when the overburden for the dam abutments and quarry is removed, during grading for the construction haul road, during clearing and constructing cuts and fills for road relocation, and during construction of the wetlands in the south end of the reservoir. Some soil disturbance can be expected during clearing of the main pool area of the reservoir. Since all soils would be stripped, it can be expected that they would be thoroughly mixed during excavation and transported for use in various locations in the project area. Mixing may result in loss of productivity to such a degree that these displaced soils would require chemical fertilization to provide for proper revegetation. The soils remaining in the reservoir clearing limits would be lost for the life of the project. The 115 acres of prime farmland would be lost.

Subsurface drainage may be required in the irrigated areas of Yoncalla and Scotts Valleys. This would require excavation of 2-foot wide strips of topsoils. These strips of topsoil would be stockpiled next to the trench, and then replaced after the drainage pipes are laid in the trench.

3.1.3.2.2 Operation

Operation of the project would not cause any additional significant loss of soils or their productivity, however some increased erosion during the first few years of operation would be expected to occur. Some of the inundated soils would be transported and deposited in the lower portions of the reservoir pool while others would be deposited downstream of the dam.

Irrigation of land is not expected to cause significant erosion or loss of soils. The use of chemicals during irrigation would increase soil productivity, without causing soil loss. Irrigation drainage systems would not affect soils or land or significantly affect the quality of return flow water.

3.1.3.3 Mitigation of Impacts to Soils and Land

Mitigation of impacts to soils would include:

- Fertilizing disturbed and displaced soil, prior to revegetation.
- Wetting down soils during construction activities.

- Stockpiling topsoils which would be later used in landscaping the recreation areas and other areas disturbed during construction.

- Topsoils excavated for drainage trenches would be the returned to upper levels of the trenches.

Mitigation of land resources is not anticipated for the irrigation service area because no adverse impacts have not been identified.

3.1.4 Mineral and Aggregate Resources

3.1.4.1 Existing Mineral and Aggregate Resources

Mineral properties in the study area were identified (Bureau of Mines, 1990) by the Bureau of Mines Mineral Industry Location System (MILS) (Figure 3-4-1). No mines are known to be active. The 24 properties include sand and gravel, crushed stone, and mercury. In addition to the MILS data, recent BLM mining claim records account for activity on lands with federally owned mineral estate. The federally owned mineral estate for the study area (as of 1984) is shown in Figure 3-4-2 at a scale to the nearest square mile. Three claim groups, two lode and one placer, were identified. None of them are active.

High-alumina clay occurs at several localities in the Fisher formation. Only the Hobart Butte deposit, located in Sec.31, T.22S., R.3W., and Sec. 36, T. 22S., R.4W., is believed large enough to be of economic interest. Most clay in the deposit is kaolinite of sedimentary origin; however, a minor amount is derived from hydrothermal alteration. Sulfides of hydrothermal origin are also distributed throughout the deposit. The most abundant are realgar (AsS) and stibnite (Sb_2S_3), but these are limited to a few pounds per ton.

Three igneous rock types in the area are useful as crushed rock. They are basalt flows from the Umpqua formation, andesite flows from the Fisher formation, and intrusive gabbroic rock. Large deposits of alluvium, mostly river deposits, occurring throughout the area are potential sources of sand and gravel.

Western Oregon is generally untested for oil and gas, but most of the subbasin is considered to have moderate potential for these commodities. Possible petroleum reservoir rocks include the Tyee and the Spencer formations. Local studies determined that sedimentary rock units between basalt flows of the Umpqua formation are too thin to contain significant petroleum reservoirs.

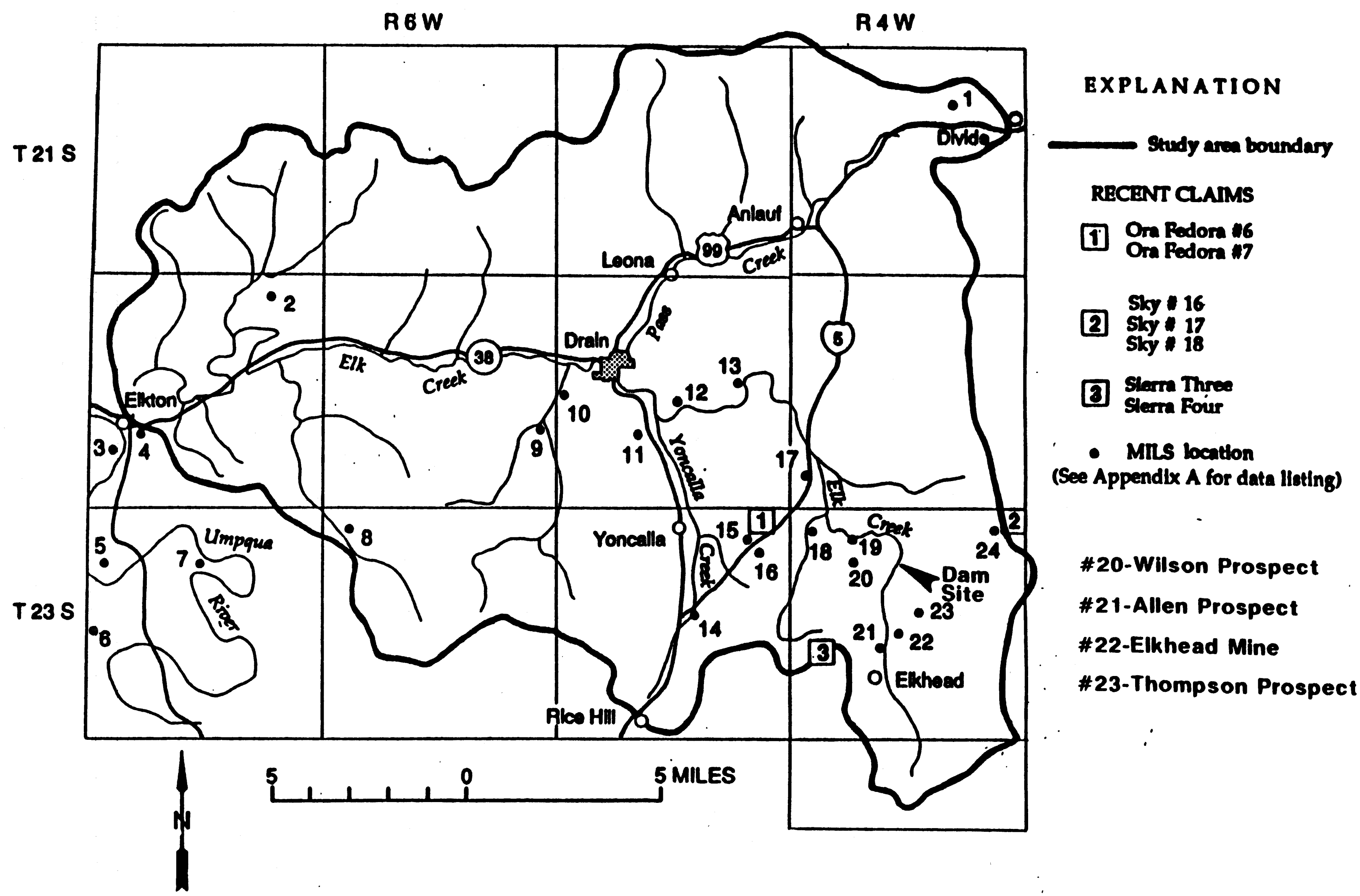


Figure 3-4-1. Location Map of Past and Present Mineral Exploration and Development Activity (U.S. Bureau of Mines, 1990).

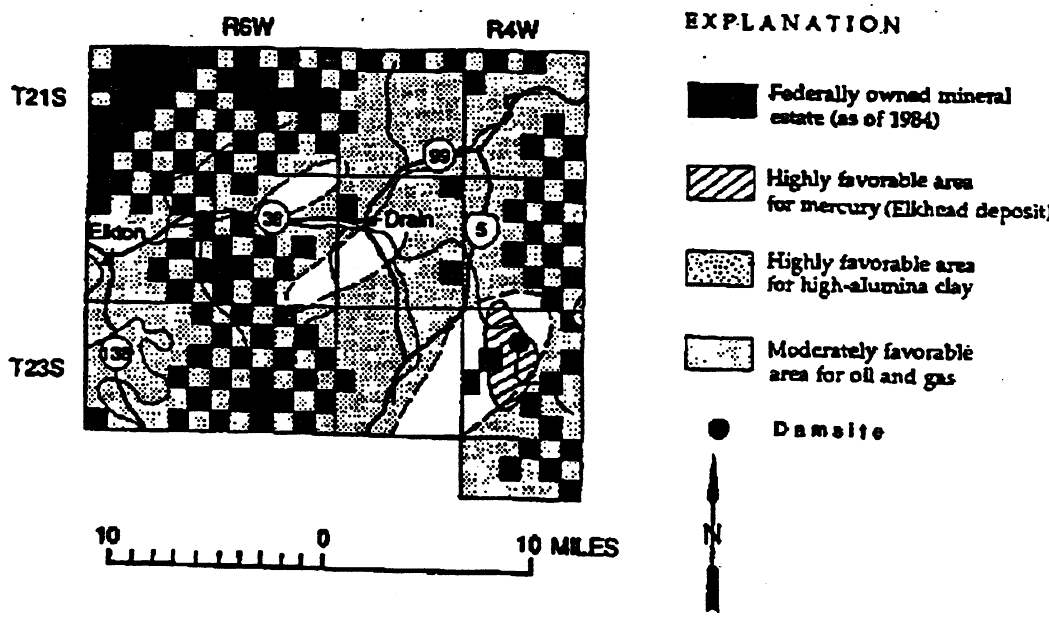


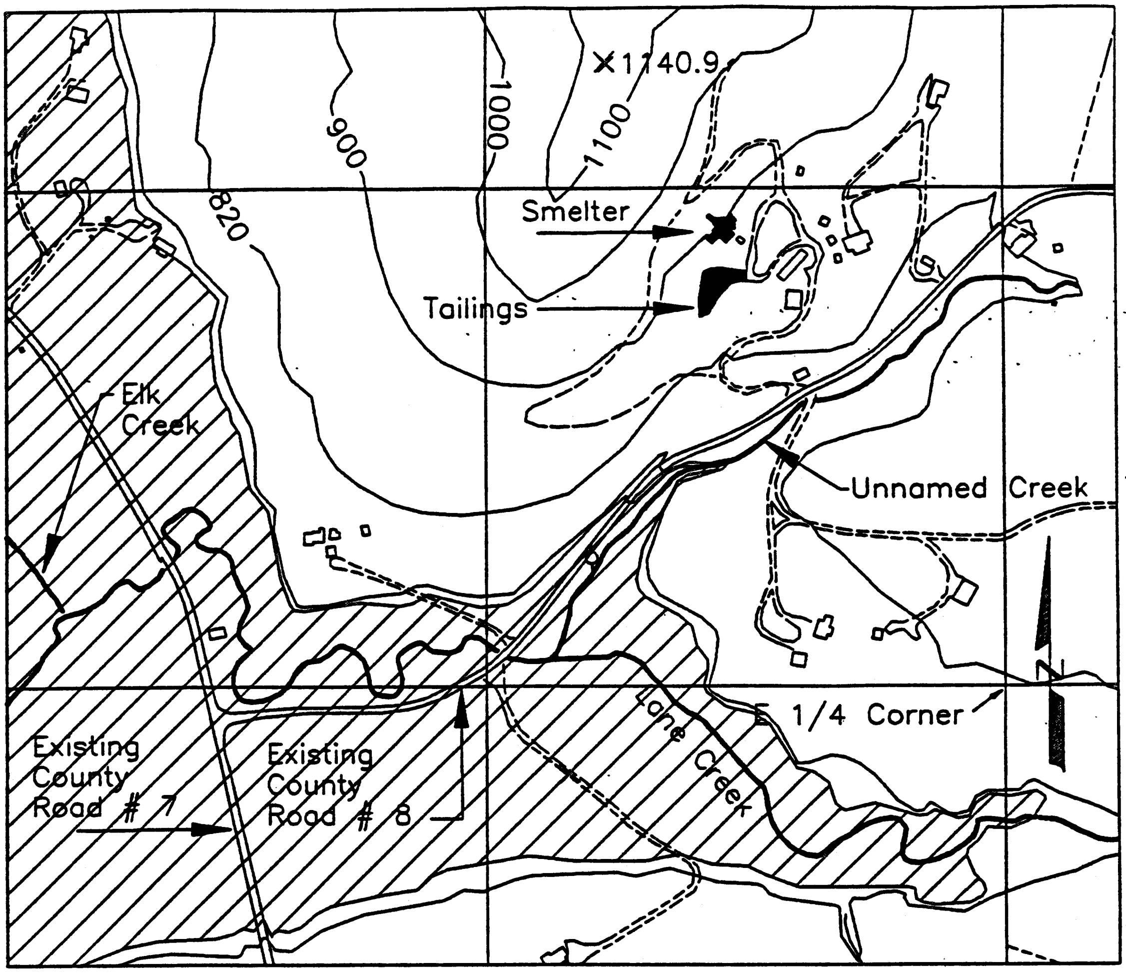
Figure 3-4-2. Federally owned mineral estate and mineral resource potential (Bureau of Mines, 1990).

Four mercury (Cinnabar-H_2S) properties occur within the project area. They are the Elkhead Mine in the NE1/4 Sec. 21, T.23S., R.4W. the Thompson Prospect in the SW1/4 Sec. 15, T.23S., R.4W.; the Wilson Prospect in the N1/2 N1/2. Sec. 8, T.23 S., R.4W.; and the Allen Prospect in the N1/2 SW1/4. Sec.21, T.23S., R.4W. The latter mine is located within the project "take line". However, significant mineral development occurred only at the Elkhead Mine. The Elkhead deposit was discovered in 1870 and was worked intermittently until 1971. Development consists of an open cut and 1,800 ft of underground workings which explored the ore zone to a depth of 150 ft. Just 87 flasks (76.5 lb per flask) were produced until 1965; from 1965 to 1971, 464 flasks were recovered from 17,647 tons of ore averaging 2 lb mercury per ton. Production costs averaged $9.34 per ton ($295.96 per flask). The mine closed in 1971 when the average price for mercury dropped to $292.41 per flask. By July 1978 the estimated costs to operate the mine has risen to $524 per flask while the average price for mercury was $150 per flask. The property is currently owned by Bill Dedmore, who acquired the land for residential purposes. There appears to be no current exploration or development for mercury within the study area.

The location of the Elkhead Mine relative to the reservoir pool elevation is shown in Figure 3-4-3. The tailings areas observed during field visits in 1991 consisted of an area at the end of a conveyor that moved the processed ore from the smelter to a tailings pile. The tailings at the end of the conveyor were then pushed to a small ravine and leveled. The existing tailings consist of about 500 cubic yards at the end of the conveyor and about 2,200 cubic yards in the ravine. The depth of the tailings at the end of the conveyor is about 15 feet. Tailings in the ravine are between 4 and 8 feet deep. Surface area of the tailings is about 50 feet by 100 feet. An inspection of the site showed the surrounding vegetation and underlying soil to be relatively stable. No evidence was noted of marked earth movement or slippage, including the existence of displaced or bent trees. Also, the demarkation between natural soils and the mine tailings is readily apparent, indicating that the tailings have remained essentially intact for a considerable period of time.

Although the potential for discovering additional mercury resources is high in the region, including in the Elkhead deposit, it seems unlikely that exploration and development will occur in the foreseeable future due to the probable small deposit sizes and high operating costs. The world mercury commodity summary shows a current excess of mercury in government stock piles. It also indicates that, at current production rates, there are sufficient world resources for about 100 years. Presently, only one domestic mine is producing mercury as the primary commodity. Remaining domestic mercury is produced as a byproduct from nine gold mines or as secondary mercury recovered through recycling. If additional domestic production is needed, it will most likely come from large

TOWNSHIP 23 SOUTH, RANGE 4 WEST
PORTION OF SECTION 21



SCALE

0 500 FEET

Improved Road..

Unimproved Road..

Reservoir Normal Pool elevation at 775 feet msl.........

FIGURE 3-4-3
MILLTOWN HILL PROJECT
LOCATION OF ELKHEAD MINE

Source: Douglas County Public Works Department known resources, improved byproduct recovery, and increased secondary recovery.

The aggregate needs of the project will be taken from the Otten Quarry, located in the E1/2 NW1/4, Section 16 (Figure 2-2). Approximately 300,000 cubic yards of rock would be extracted from the site and would be used in the construction of the dam. The rock would be moved to the contractor work area for processing into various sizes necessary for incorporation into the RCC mix for the dam. In general geologic conditions at the 14-acre quarry site are similar to those at the damsite. Laboratory testing of cores indicates an ample supply of material suitable for RCC use.

3.1.4.2 Impacts to Mineral and Aggregate Resources

The two features of the project that could adversely affect mineral resources are the dam and reservoir. Based on a 775 ft elevation for the water surface, the dam and reservoir will be almost entirely within the high mercury potential zone. However, this potential zone is based on projections between the four mercury properties previously discussed. Consequently, only portions of the zone are hydrothermally altered at ground surface and represent areas of high potential. Additionally, detailed geologic mapping indicates that only minor occurrences of altered rock are exposed below 800-ft elevation. Therefore, impacts on known and potential mercury resources probably would be insignificant.

No past or current mineral development activity has or is expected to occur in the area to be inundated. Future use of mineral resources could come from commercial sand and gravel operations.

Alluvium deposits with potential for sand and gravel development occur in Section 28, T.23S., R.4W. at the upper portion of the reservoir site. However, there are several larger deposits outside of the reservoir area, which are nearer to potential markets. Sand for construction of the dam (98%) would probably come from on-site crushing activities. The remaining 2% would be transported to the site from commercial quarries.

No potential oil and gas resources would be significantly affected by the project, since most of the reservoir area would inundate a portion of the Umpqua formation, which has been determined to have low potential for this resource.

If mining of the Elkhead deposit were to become economically feasible in the future because of increased mercury prices and/or improved mining methods, restrictions for extracting and processing the ore would most likely be in the form of increased stringent water quality standards enforced by the state of Oregon.

Extraction of 300,000 cubic yards of rock material at the Otten Quarry would require the removal of all vegetative cover, topsoil, and weathered rock not suitable as aggregate material. All vegetative material would be piled and burned on site, the topsoil would be stockpiled, used for rehabilitation of the quarry after all suitable rock has been removed. The weathered rock would be stockpiled on site. The quarry is situated about a horizontal 200 feet from the full-pool elevation of 775 feet msl.

3.1.4.3 Mitigation of Impacts to Mineral and Aggregate Resources

Project impacts to aggregate resources would be mitigated by using on-site sand, gravel, and rock for project construction purposes. Mitigation actions would be taken to rehabilitate the Otten Quarry after all suitable rock has been extracted. These actions would include the following:

- The stockpiled, weathered rock would be replaced over the surface of the quarry floor.
- The topsoil would be spread over the quarried surface and the replaced weatherized rock.
- The topsoil would be seeded with grasses, shrubs and planted with native tree seedlings.

No measures are believed necessary to mitigate any adverse impacts to other mineral resources. The potential for future development in the area for mercury and for oil or gas remains low.

3.1.5 Climate

3.1.5.1 Existing Climatic Conditions

Temperatures in the Elk Creek subbasin are typically mild. The four seasons of the year usually blend into one another without abrupt changes. The average, maximum and minimum temperature, precipitation and snow for 1949-1986 are shown below (Douglas County Water Resources Survey, 1990):

	AVERAGE ANNUAL	MAXIMUM YEAR	MINIMUM YEAR
Temperature (F)			
Drain	53.0	107.0	0
Elkton	54.5	108.0	6
Precipitation (inches)			
Drain	48.4	64.3	32.1
Elkton	54.4	74.1	34.8
Snow (inches)			
Drain	3.25	23.20	0
Elkton	6.14	41.50	0

Extreme temperatures are uncommon due to the proximity of the subbasin to the Pacific Ocean. Occasionally in midwinter, a dry polar continental air mass invades the area for a short duration bringing freezing temperatures into the subbasin. In a normal winter, there are about 41 days in which the temperature falls below the freezing point. Temperatures of 90 degrees are exceeded about 20 days of the year.

Rainfall data has been collected continuously at both the Drain and Elkton gages since the fall of 1948. Average annual precipitation is about 10% higher at Elkton than at Drain. Due to the relatively low elevations in the area, snowfall in the subbasin melts rapidly. For the Drain gage, an average of 3.25 inches of snow falls in a year, while at the Elkton gage, an average of 6.14 inches falls in a year. The average precipitation (inches) at Elkton for 1949-1986 is as follows:

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
9.94	7.03	6.56	3.50	1.99	0.96	0.41	0.64	1.39	4.15	7.60	10.55	54.52

Source: Bureau of Reclamation, 1991.

Although annual precipitation is relatively high, only about 20 percent or about 9 inches occurs during the growing season (June through August). An isohytal analysis (Hill, 1971) estimated the average watershed precipitation at 57.6 inches.

Flood-producing storms occur mainly in the winter and occasionally in late fall and early spring. The typical winter storm results from the southward displacement of the Aleutian low pressure area accompanying frontal systems. Storms usually originate over the northwest Pacific Ocean, so accompanying air masses have a long trajectory over relatively warm water and acquire a high moisture charge. A series of waves at times forms within the low pressure area and, moving eastward, cause widespread precipitation over much of the west coast of the United States. General storms of this nature, augmented by orographic lifting of the moisture laden maritime air by the Coast Range, cause nearly all the flood-producing storms in the area (Bureau of Reclamation, 1991).

Data on wind speed and direction is available at the Roseburg airport. On the average, wind velocity at Roseburg is 4.9 miles per hour with a prevailing direction of north to northwesterly. The prevailing direction varies with the season, being from the south and west during the winter months and from the north and west during the rest of the year. The highest wind gust recorded at the Eugene, Oregon, station (located approximately 70 miles north of the project area) was 86 miles per hour on October 12, 1962, with sustained winds of 63 miles per hour.

The growing season is the duration of time between the last freeze of the spring (32 degrees F) and the first freeze of the fall (32 degrees F). Based on the period of 1949 to 1986 at the Elkton gage, the last freeze of the spring will occur on April 4, and the first freeze of the fall will occur on November 7. This results in a growing season of 217 days. Some grass and legume crops are more tolerant of freezing, so a growing season based on a 28 degree F temperature was also developed. The 28 degree F temperature extends from February 12 to December 6 (296 days) on the average. For less tolerant crops a 36 degree F growing season was also computed. The 36 degree F growing season extends from May 5 to October 17 (164 days). The growing season, based on 32 degrees F at the Elkton gage, has varied from 149 days in 1970 to 310 days in 1979 (Bureau of Reclamation, 1991).

3.1.5.2 Impacts on Climate

The project would not affect climatic conditions, however, climate could affect project operation. Critical high air temperatures and/or low water years would affect the drawdown rate to maintain downstream water temperatures needed for the enhancement of anadromous fish habitat (See: Section 3.1.15, Fisheries Resources). Low water years and resulting low water storage could affect other project needs, such as irrigation, and municipal and industrial uses.

3.1.5.3 Mitigation

No mitigation is planned because no impacts are anticipated.

3.1.6 Air Quality

3.1.6.1 Existing Air Quality

The proposed project is within the Southwest Oregon Air Quality Control Region (Bureau of Reclamation, 1991). Both the Federal government and the State of Oregon have developed standards for allowable levels of certain pollutants. Certain areas have been designated in the Clean Air Act as areas for the prevention of significant deterioration (PSD). The project area is entirely within areas designated as Class II (moderate degradation allowed). The nearest Class I areas (virtually no degradation allowed) are Diamond Peak Wilderness, and Crater Lake National Park, about 60 miles and 80 miles from the project site, respectively.

Pollutants in northern Douglas County are generated primarily by exhausts from home heating, vehicular traffic, and timber operations. Only timber operations have significant effect, and then only when considerable amounts of logging slash are burned. Because of the intermittent and spotty nature of slash burning, its effects are relatively brief, (usually 2 to 3 weeks after the first heavy rainfall in the fall, and 2 to 3 weeks in the spring).

3.1.6.2 Impacts to Air Quality

3.1.6.2.1 Construction

The construction phase of the project would produce short-term adverse impacts on local air quality. These would result from exhaust pollutants generated by construction vehicles and equipment both at the site and during transit of materials from the quarry. The effect of these vehicular emissions on ambient air in the well-ventilated, unconfined airsheds would be slight and well within allowable limits.

Impacts would also be caused from fugitive dust, at the construction site, along the access road, and during rock excavation and crushing. These impacts would be temporary and of little overall significance. Annoyance to residents living along access routes to the project site can be expected. Air quality impacts during the construction phase of a project are exempt from Oregon air quality standards (Oregon Administrative Rules 340-31-150).

3.1.6.2.2 Operation

Operation of the dam is not expected to have an adverse impact on air quality. Exhaust and dust from recreational vehicles and recreational activities would not be significant. County Roads #7 and #8 have bituminous surfaces near the reservoir.

3.1.6.3 Mitigation of Air Quality Impacts

Construction specifications would require the contractor to comply with applicable Federal, State, and local air quality standards and emission limitations adopted in accordance with or effective under the provisions of the Clean Air Act (Public Law 91-604), as amended by the Clean Air Amendments of 1977 (Public Law 95-95). During construction, the contractor would be required to use such methods and devices as reasonably available to control, prevent, and otherwise minimize atmospheric emissions or discharges of atmospheric contaminants and gases.

The emission of excessive dust into the air would not be permitted during the manufacture, handling, and storage of concrete aggregates. The contractor would be required to use such methods and equipment as are necessary for collection, disposal, or prevention of dust during these operations. Rubbish, trash, and other combustible materials (except for cleared trees and brush) would be disposed of in an approved sanitary landfill. Cleared vegetation would be burned onsite or be anchored and submerged for fish cover.

The contractor would be required to carry out measures to reduce dust and to prevent dust caused by his operations from damaging dwellings or causing a nuisance. This would include the periodic wetting of exposed soils, especially on the contractor haul road.

Long-term stabilization would be achieved by revegetating exposed areas. The planned use of overburden removed from the abutments and quarry would minimize hauling distance and avoid exposing residences to dust from trucks carrying material.

3.1.7 Noise

3.1.7.1 Existing Noise Conditions

Existing noise sources of significance include occasional log trucks, automobile traffic, and infrequent noise from agricultural and timber operations. Ambient noise levels have not been measured at the reservoir pool area. They can be assumed to approximate general values obtained for sites with similar characteristics. The only significant noise in the area now is the sound of water in Elk Creek, periodic traffic on County roads, and occasional human activity, including logging. Typical ambient noise levels for rural environments range between 32 and 40 decibels (dB). Existing ambient L10 noise levels, which reflect sound from all sources, should be less than 50 dBA. (L10 is the sound pressure level exceeded only 10 percent of the time; "dBA" is an "A scale" weighing of sound in decibels. One decibel corresponds to the smallest change in sound that can be detected by the ear. The "A scale" weighing approximates the loudness as heard by the human ear.) For comparison, 60 dBA represents the average sound level of normal conversation (Bureau of Reclamation, 1991).

3.1.7.2 Noise Impacts

3.1.7.2.1 Construction

Construction activities in the reservoir pool area would cause increased noise levels. Typically, the sounds of chainsaws and logging equipment during reservoir clearing, earthmovers, bulldozers, dump trucks, wagon drills during excavations at the damsite and at the Otten Quarry, punctured by occasional blasting, can be expected during the 3 year construction period. Increased road traffic and accompanying higher sound levels would be experienced by residents living near County roads #7 and #8. Most of the increased noise levels would not exceed 90-95 dBA, and would occur during daylight hours only.

The construction of the pipeline in the service area would result in some minor, short-term increase in noise levels during daylight hours.

3.1.7.2.2 Operation

Motorboating would be the greatest noise source during operation of the project. Boating would be concentrated in the center pool area, since a barrier would be placed across the narrower neck of the pool at the upper end. Boat access would not be permitted in the wildlife area.

3.1.7.3 Mitigation of Noise Impacts

Construction specification would require the contractor to comply with the Noise Control Act of 1972 (Public Law 92-574) as amended by the Quiet Communities Act of 1978 (H.R.12647). Boating noise impacts would be minimal because not many people would be living near the reservoir.

3.1.8 Surface Water Quantity

3.1.8.1 Existing Surface Water Quantity

Surface water flows in Elk Creek subbasin are unregulated except during the irrigation season, when minimum flows (the 1974 minimum flows were converted to instream water rights in 1989) are enforced. Low elevations and mild winters result in little snowfall, but abundant rainfall occurs during the winter and spring months. The pattern of stream flow follows the precipitation pattern with high flows in winter and spring and very low flows in summer (Douglas County Water Resources Survey, 1990).

Recorded flow extremes at the Elk Creek gage near Drain, range from a minimum daily flow of 0.0 cubic feet per second (cfs) to a maximum instantaneous flow of 19,000 cfs. This peak flow occurred on February 10, 1961. Summer flows at the gage fall below 10 cfs frequently. The mean annual flow for the period of record (1956-

1989 water years) is 209 cfs. The average annual runoff volume is 151,700 acre-feet while the smallest runoff occurred in year 1977 with 26,300 acre-feet and the largest in year 1956 with 293,400 acre-feet (Douglas County Water Resources Survey, 1990).

The 50% and 80% exceedence flows are shown in Table 3-8-1 for water years 1956-1989. Minimum perennial stream flows to protect aquatic life are also shown. Minimum flows were established in Elk Creek subbasin in 1974 and were converted to instream water rights in 1989, with their appropriate priority date.

Table 3-8-1. Elk Creek 50% and 80% Exceedence Flows at Gage #14-3220.00 (RM 26.2) Near Drain, Oregon (1956-1989).

Month	Natural Streamflow at Gage 14322000, Elk Creek near Drain, OR, at RM 26.2		1974 Minimum Perennial Streamflows (cfs) Converted to Instream Water Rights in 1989		
	50% Exceedence Flow (cfs)	80% Exceedence Flow (cfs)	RM 33.8 to 24.2	RM 24.2 to 12.7	RM 12.7 to 0
Oct 1-15	8	3	10	15	10
Oct 16-31	13	6	30	70	50
Nov	185	28	70	110	110
Dec	357	200	70	110	110
Jan	476	190	70	110	110
Feb	487	225	70	110	110
Mar	321	177	70	110	110
Apr	169	75	70	110	110
May	80	41	50	70	80
Jun	27	17	25	30	50
Jul	6	4	7	15	15
Aug	2	1	5	10	10
Sep	3	2	5	10	10

Exceedence flows are based on mean monthly flows for the project operational study period of water year 1925-1989. Flows for years 1925-1955 (31 years) were synthesized. Flows for years 1956-1989 (34 years) are gaged. Exceedence is the percent of months that had a mean monthly greater than or equal to the listed flow.

Source: Douglas County Water Resources Survey, 1990.

Water rights for irrigation, domestic use, stockwater, and log ponds are shown in Table 3-8-2. There are rights for about 19 cfs in the subbasin (exclusive of instream water rights). Of the 19 cfs, only about 1.57 cfs are upstream of the proposed damsite.

Table 3-8-2. Water Rights for Irrigation, Domestic Use, Stockwater, and Log Ponds.

LOCATION	CFS*	AC-FT**	ACRES**
RM 0 - 5.2	2.92	608	243
RM 13.36 - 22.0	7.73	1,511	604
RM 22.4 - 25.86	0.95	185	74
RM 26.25 - 35.29	4.61	1,092	437
RM 35.59 - 37.16	.97	223	90
RM 40.48 - 45.41	1.57	312	125
	=====	=====	=====
TOTAL	18.75	3,931	1,573

* Rounded to nearest 0.01
** Rounded to nearest 0.1

Source: Douglas County Water Resources Survey, 1990.

Current water use and availability during April through October in Elk Creek subbasin are graphically summarized in Figure 3-8-1. The average flow represents the amount of stream flow that has occurred in 4 out of 5 years, based on USGS/Douglas County records for the cited gage. The horizontal "stair-step" lines represent the legal limit of diversions for all purposes. The lines delineate the chronology of important events in water resource management that have occurred in Elk Creek. Water rights acquired prior to 1974 are shown as the lower band for each month. The next band includes the minimum flow established in 1974 and the pre-1974 rights. Rights acquired after 1974 (through 1987) are also shown (Myers, 1989).

Flow rates in Elk Creek are inadequate to meet instream water rights established in 1974 and rights acquired thereafter, from mid-April through October in most years (Figure 3-8-1). Pre-1974 rights are not met between July and October for most years. Flows decrease to nearly zero in July and do not recover until after mid-September. Thus, all water uses are curtailed in Elk Creek nearly every summer. As stream flows decrease to amounts less than necessary to meet all water rights, the Watermaster administers the stream under the prior rights doctrine. In the case of irrigation water rights, diversions under the most recent rights are stopped. In the case of municipal rights, when junior to instream water rights, diversions are reduced to equal the "human consumption" or domestic component of the right. Domestic rights and stockwater would be allowed to continue diversion if water is available (Myers, 1989).

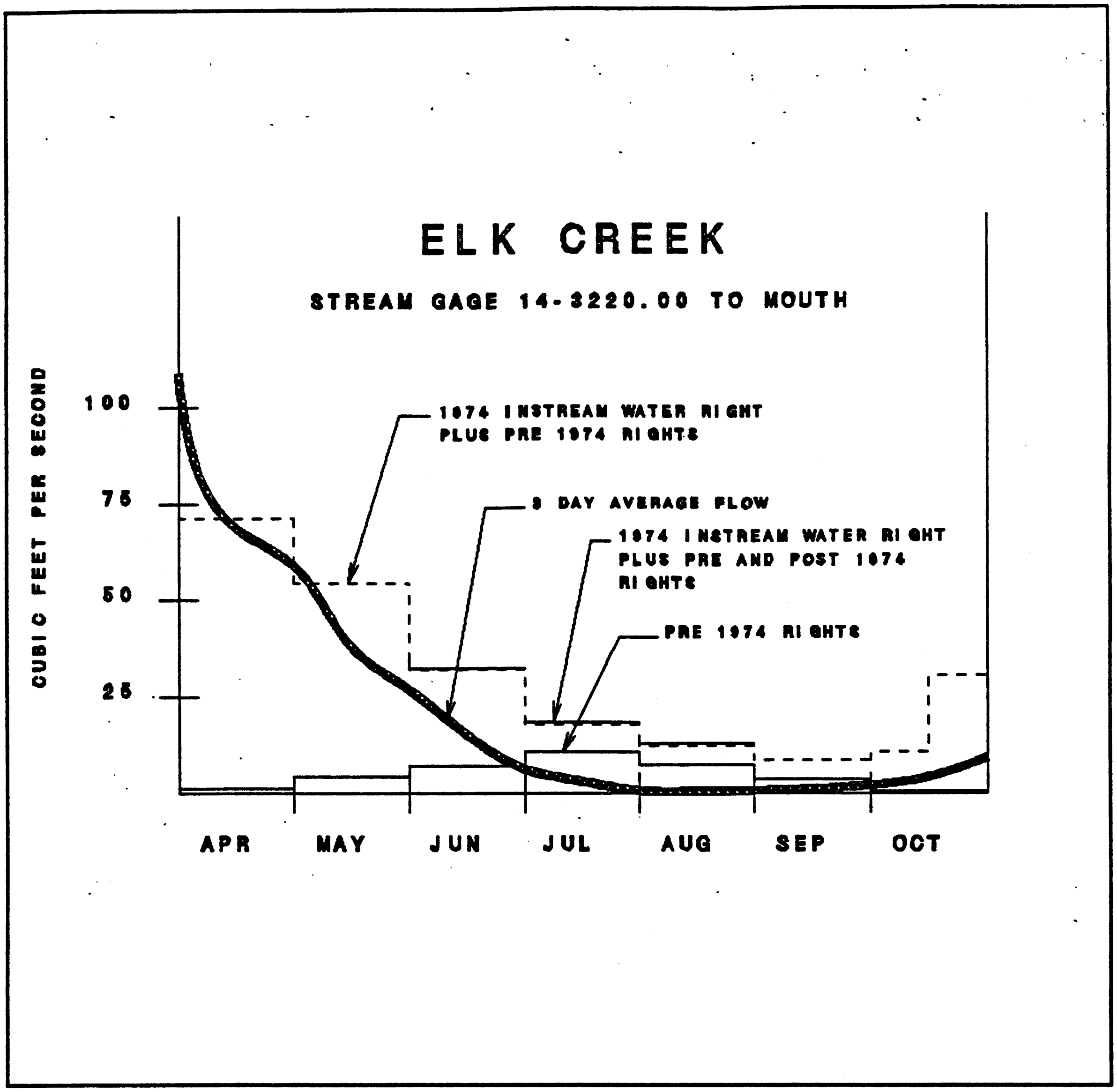


Figure 3-8-1. Comparison of Average Flow and Water Rights (Myers, 1991). Water Years 1965 - 1984.

The lack of flood control structures on Elk Creek has resulted in high streamflows that damage both urban and rural property. Floodflows in the Elk Creek subbasin most often occur from November through March, usually after heavy winter rains. In some years, low elevation snowmelt accompanying a rainstorm may increase the flooding. The largest flood of record, estimated to be greater than a 50-year recurrence interval flood, occurred on February 10, 1961, when a maximum instantaneous flow of 19,000 ft^3/s was recorded on Elk Creek downstream of its confluence with Yoncalla Creek (Douglas County Water Resources Survey, 1990).

Property damage from flooding tends to be concentrated in the city of Drain where industrial, commercial, public, and residential developments are located on the Elk Creek and Pass Creek flood plains. During high flow periods, backflows from Elk Creek enter the lower reaches of Pass Creek and exacerbate flood damages near their confluence. Damages to agricultural lands and woodlots occur in the rural areas both upstream and downstream of Drain. Bridges in Drain and in the outlying areas are subject to damage from high floodflows.

In 1979, the Federal Insurance Administration, Department of Housing and Urban Development completed a flood insurance study for the city of Drain and identified a flood frequency analysis to determine the flood discharges for Elk and Pass Creeks. The summary of the results from that study is shown in Table 3-8-3.

Table 3-8-3. Flood Frequency and Summary of Discharges for Elk Creek Near Drain.

Flooding source and location	Drainage area (sq mi)	Peak discharges (ft^3/s)				
		2-year	10-year	50-year	100-year	500-year
Elk Creek above Pass Creek	105	5,950	12,000	18,500	21,100	28,600
Elk Creek below Pass Creek	168	8,240	17,000	26,000	30,400	41,600

Source: Federal Insurance Administration, 1979.

Studies performed by the County and the U.S. Army Corps of Engineers estimated flood damages that are anticipated without the project for each size flood. The results of these studies are summarized in Table 3-8-4. Based on these studies, average annual flood damages in the Elk Creek subbasin are $205,000. The distribution of these annualized damages is shown in Table 3-8-5 (Bureau of Reclamation, 1991).

Table 3-8-4. Flood Damage Summary, Elk Creek.

Flood size[1]	Amount[2]
2-year	--
10-year	$ 405,000
50-year	1,065,000
100-year	1,479,000
500-year	2,969,000

[1] Recurrence interval of flood.
[2] Total damages anticipated from flood based on current level of development.

Table 3-8-5. Average Annual Flood Damages Along Elk Creek[1].

Damage classification	Value
Woodlot and pasture	$74,545
Bridges	81,038
Residential	36,875
Commercial	5,089
Public buildings	3,305
Industrial	4,170
Total	$205,022

[1] Annualized damages based on projected recurrences of 2-, 10-, 50-, 100-, and 500-year flood events.

3.1.8.2 Impacts to Surface Water Quantity

3.1.8.2.1 Construction

Water quantity would not be affected during construction of the project. All present statutory requirements would be met.

3.1.8.2.2 Operation

Operation of the Milltown Hill Dam and reservoir would change the flow regime of Elk Creek dramatically below the dam. Water quantities would remain unchanged. Excess winter flows, those flows not needed to meet instream flow requirements, would be stored in the reservoir for release later in the year to meet downstream needs for fisheries resources, irrigation, municipal, and industrial demands.

A comparison of the average monthly flows below the dam, at Drain, and at the mouth for both pre- and post-project conditions are shown in Figures 3-8-2, 3-8-3, and 3-8-4. Project Flows are consistently higher than pre-project flows at all 3 locations for low flow months. Flows for water years 1957-58 (average water

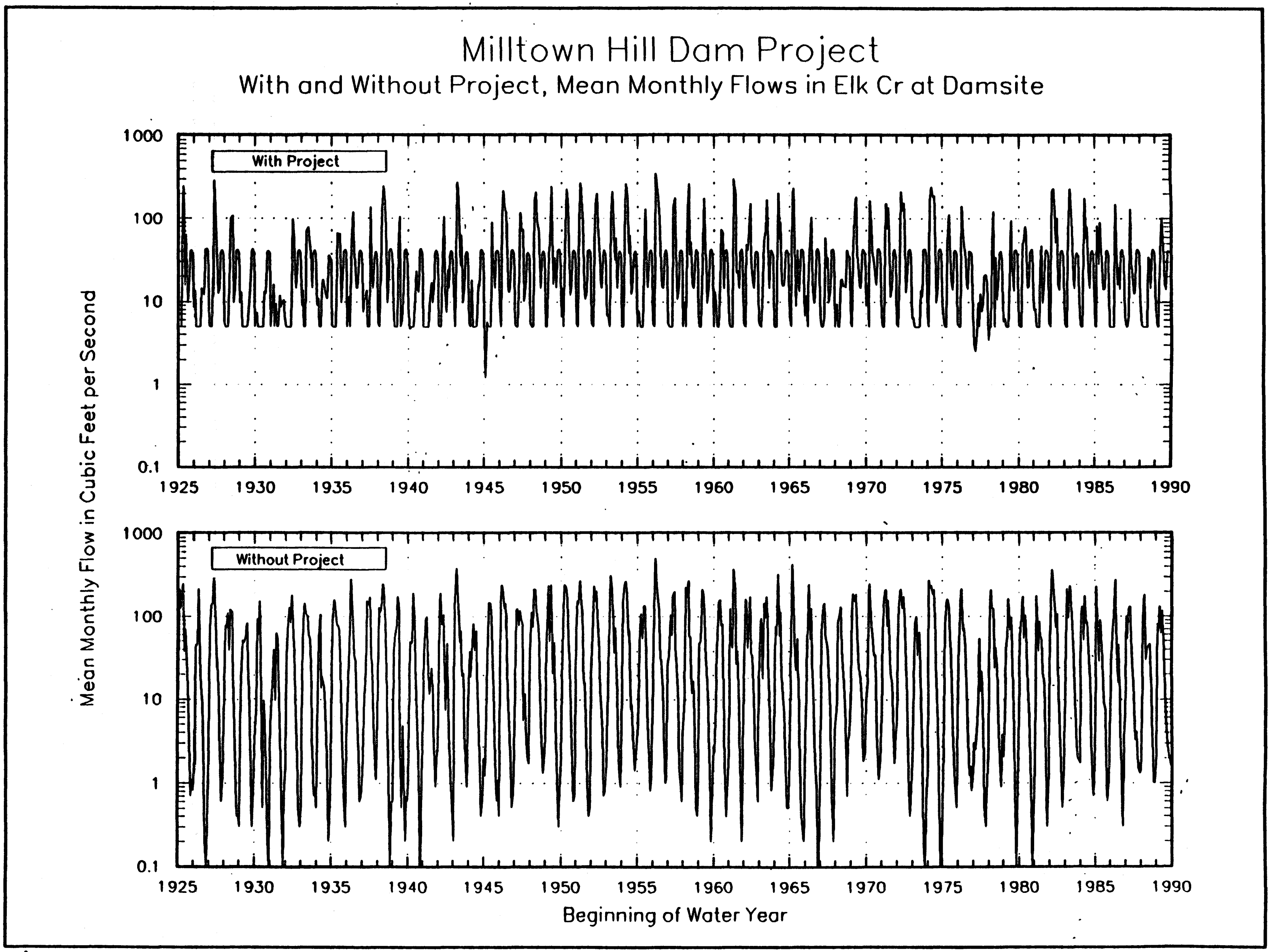


Figure 3-8-2: Natural and Regulated Flows at the Damsite (Douglas County Water Resources Survey, 1990).

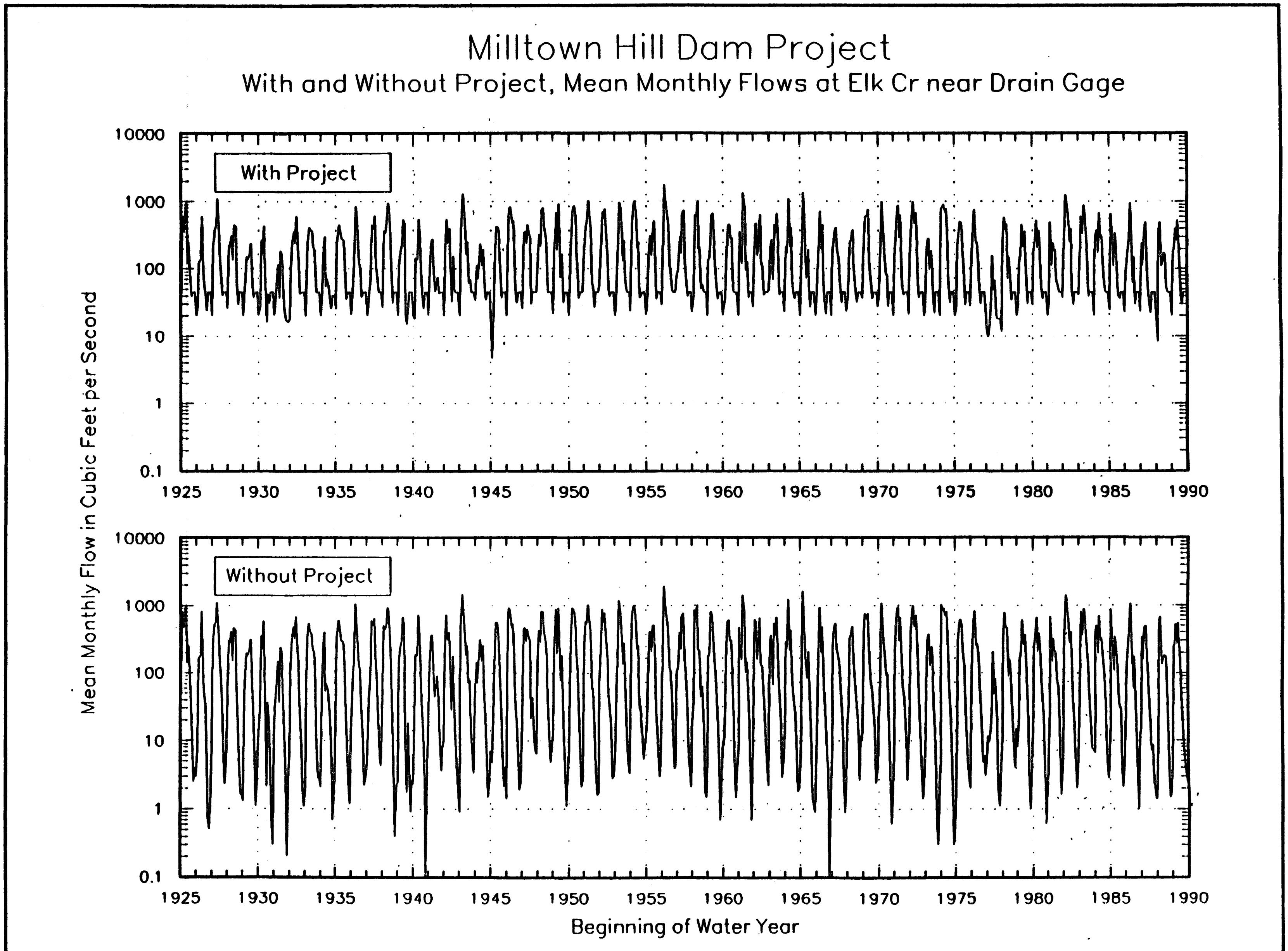


Figure 3-8-3: Natural and Regulated Flows at Drain (Douglas County Water Resources Survey, 1990).

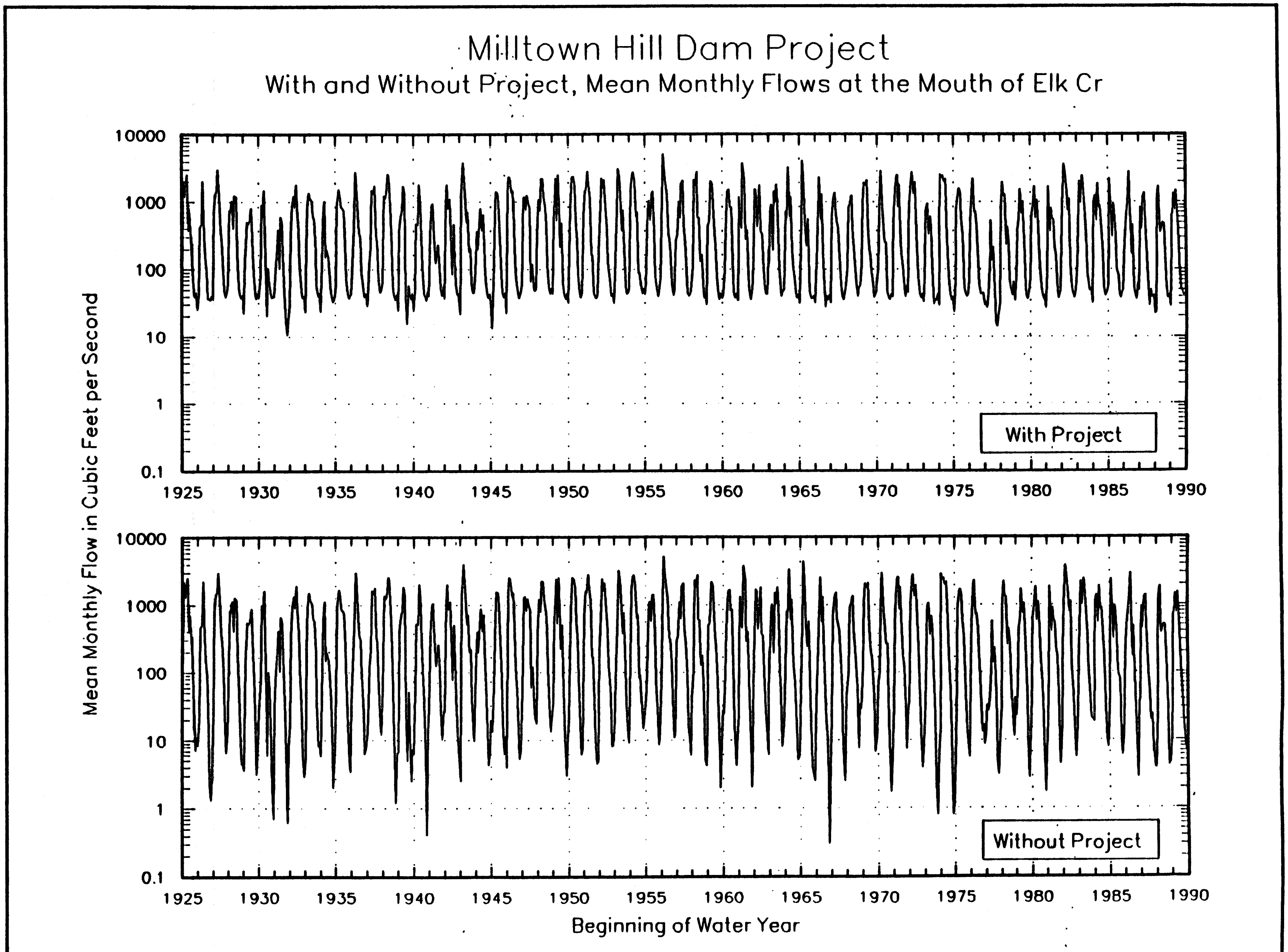


Figure 3-8-4: Natural and Regulated Flows at Elkton (Douglas County Water Resources Survey, 1990).

year) and 1977-78 (low water year) are shown in Tables 3-8-6 and 3-8-7. The flows show the existing condition for the summer months in comparison to the project flows. An additional fish flow is also shown and arbitrarily distributed according to the acre-feet available for fisheries resources for those years.

The acre-feet available for enhancement of fisheries resources would vary from year-to-year depending on water year and downstream demands. In these examples, 6,280 and 1,922 acre-feet would have been available in 1957 and in 1977, respectively. Figure 3-8-5 shows exceedence for the storage release for fish. Although the storage allocation for fish is 7,737, about 50% of the time storage would have exceeded 7,000 acre-feet, while 90% of the time it would have exceeded 5,000 acre-feet, depending on water year (Douglas County Water Resources Survey, 1990).

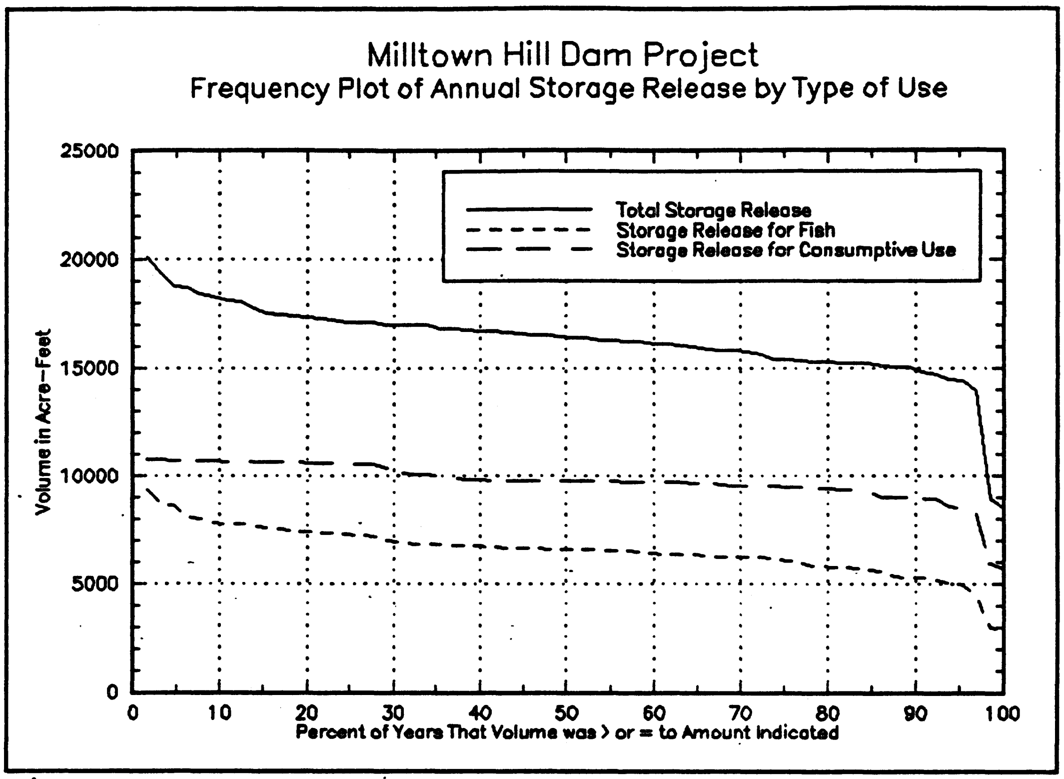


Figure 3-8-5. Storage exceedence curves for total storage, fish storage, and consumptive use (Douglas County Water Resources Survey, 1990).

Flow duration curves of the July-September period for both pre- and post-project conditions at the dam, Boswell Springs (river mile 26.5), and mouth are shown in Figures 3-8-6, 3-8-7 and 3-8-8. Under the post-project condition, a target flow of 5 cfs at the dam is met 100 percent of the time. A target flow of 45 cfs at Boswell

Table 3-8-6. Flows (cfs) at selected locations in Elk Creek for a low water year (1977-78) with and without Milltown Hill Reservoir.

Location	May	June	July	August	Sept	October
Dam						
Project[1]	7	10	10	10	6	3
Fish Flow[2]	0	0	10	11	11	0
Total Project	7	10	20	21	17	3
Existing	22	5	0.5	0.3	1	3
Boswell Springs						
Project	67	21	8	7	7	12
Fish Flow	0	0	10	11	11	0
Total Project	67	21	18	18	18	12
Existing	82	18	2	1	4	11
Below Pass Creek						
Project	118	31	18	17	19	18
Fish Flow	0	0	10	11	11	0
Total Project	118	31	28	28	30	18
Existing	133	29	3	2	7	18
Above Big Tom Folley						
Project	181	43	6	3	10	27
Fish Flow	0	0	10	11	11	0
Total Project	181	43	16	14	21	27
Existing	197	42	5	3	10	27
Mouth						
Project	212	49	6	3	11	31
Fish Flow	0	0	10	11	11	0
Total Project	212	49	16	14	22	31
Existing	229	49	5	3	11	31

1 Project flows include natural flows for prior water rights, and project storage flows for project municipal and industrial and irrigation demands.

2 Fish flows would be released at the discretion of ODFW.

Source: Douglas County Water Resources Survey, 1990.

Table 3-8-7. Flows (cfs) at selected locations in Elk Creek for an average water year (1957-58) with and without Milltown Hill Reservoir. Flows rounded to nearest integer.

Location	May	June	July	August	Sept	October
Dam						
Project[1]	10	14	19	20	11	4
Fish Flow[2]	0	0	25	26	32	5
Total Project	10	14	44	46	43	9
Existing	25	9	2	1	1	4
Boswell Springs						
Project	78	38	16	15	8	15
Fish Flow	0	0	29	30	37	8
Total Project	78	38	45	45	45	23
Existing	94	34	6	4	2	15
Below Pass Creek						
Project	137	58	18	15	8	23
Fish Flow	0	0	29	30	37	8
Total Project	137	58	47	45	45	31
Existing	153	54	9	6	3	24
Above Big Tom Folley						
Project	208	81	15	10	6	35
Fish Flow	0	0	29	30	37	8
Total Project	208	81	44	40	43	43
Existing	227	81	14	8	5	35
Mouth						
Project	244	93	16	10	6	40
Fish Flow	0	0	29	30	37	8
Total Project	244	93	45	40	43	48
Existing	263	93	16	10	6	41

[1] Project flows include natural flows for prior water rights, and project storage flows for project municipal and industrial and irrigation demands.

[2] Fish flows would be released at the discretion of ODFW.

Source: Douglas County Water Resources Survey, 1990.

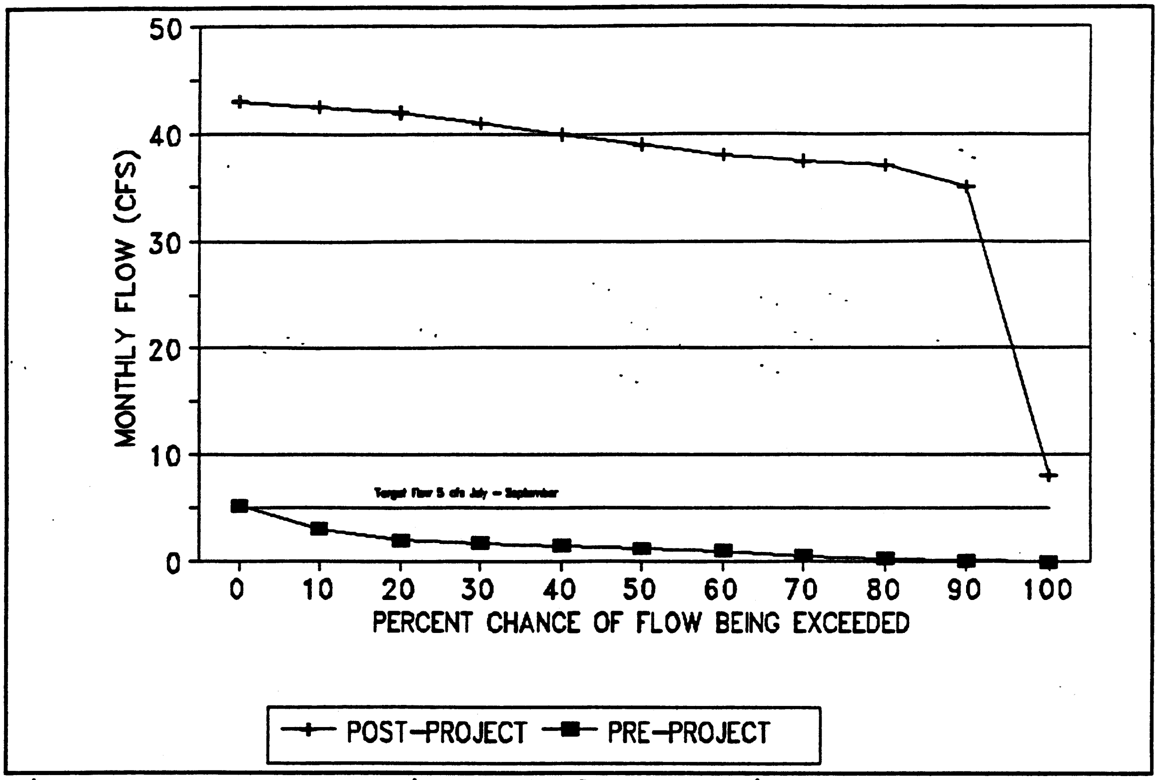


Figure 3-8-6. Comparison of Flow Duration Curves at the Dam Before and After Project Construction (Bureau of Reclamation, 1991).

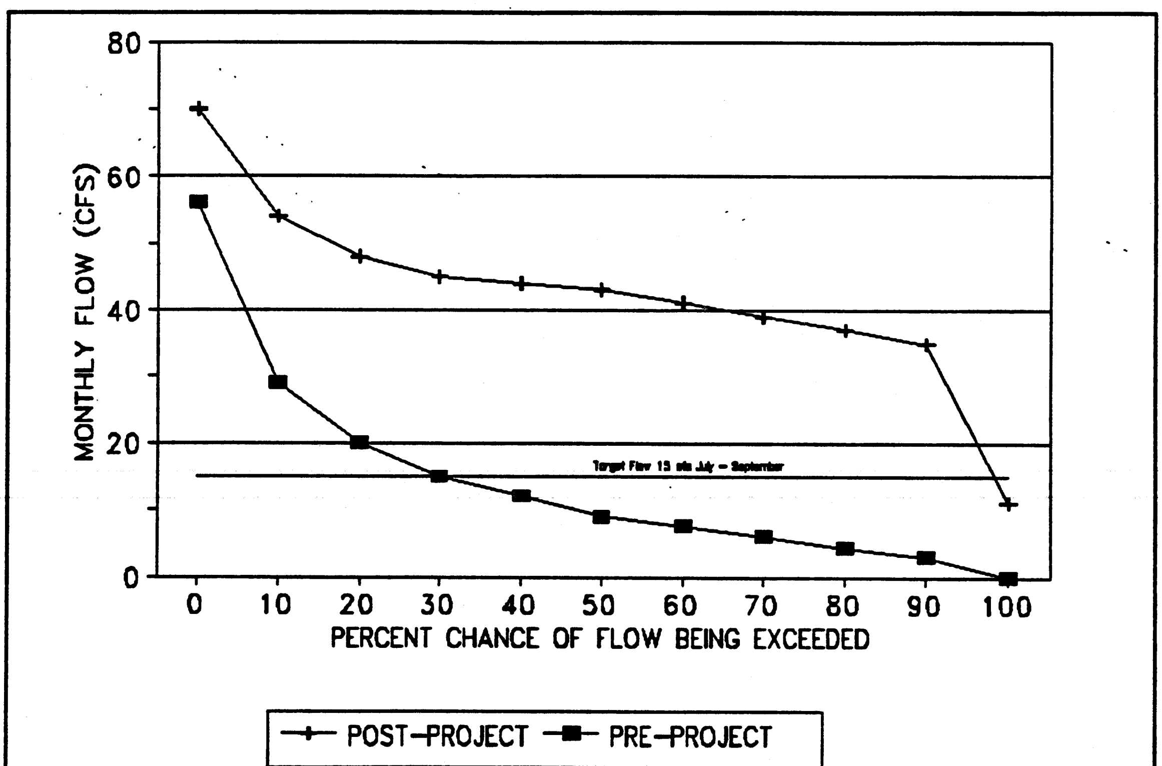


Figure 3-8-7. Comparison of Flow Duration Curves at the Mouth of Elk Creek Before and After Project Construction (Bureau of Reclamation, 1991).

Springs is met 95 percent of the time, and a target flow of 15 cfs is met 98 percent of the time at the mouth. The post-project conditions show a significant improvement in instream flows during critical flow periods (Douglas County Water Resources Survey, 1990).

Operation of the project could reduce the overbank flows by about 1 foot in Drain (K. Shumway, pers. comm., Douglas County). This would decrease flood damages.

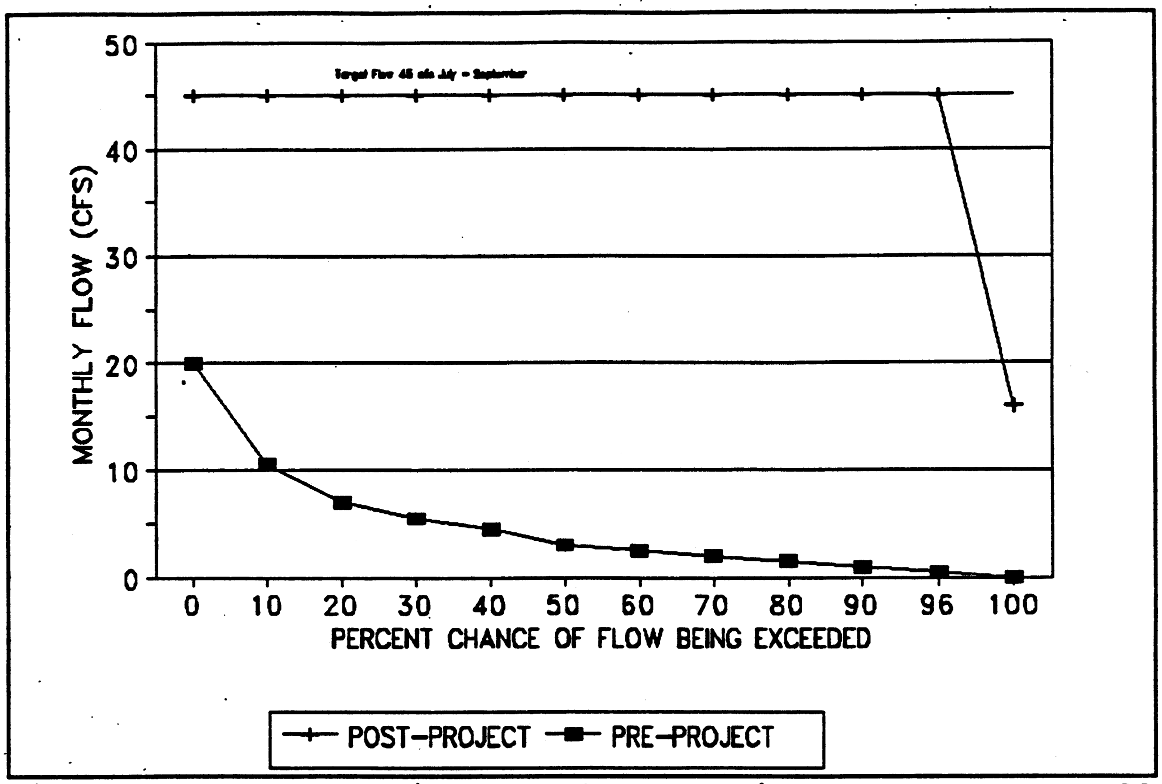


Figure 3-8-8. Comparison of Flow Duration Curves at Boswell Springs (Bureau of Reclamation, 1991).

The irrigation of croplands requires the even dispersion of water to the crops. A minor amount of this water would be lost through evapo-transpiration processes. A major amount of the irrigation water would be absorbed by the soil and become ground water. The increased amount of ground water, as a result of irrigation, would move through the soil and the excess would be deposited in the subsurface drainage system and returned to Elk Creek. Table 3-8-8 shows the cumulative monthly irrigation return flows for a normal year near Drain and at the mouth of Elk Creek in comparison to the average flow in Elk Creek. Return flows are not included in the average flow for Elk Creek.

Table 3-8-8. Cumulative Irrigation Return Flow and Average flow (cfs) in Elk Creek at the Stream Gage Near Drain (14-3220.00) and at the Mouth of Elk Creek.

Location	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (ac-ft)
Return Flow Near Drain	0.008	0.50	2.16	4.37	6.28	6.05	3.25	0.82	0.04	1,426
Average Flow Near Drain	192	87	38	44	44	44	28	180	384	52,826
Return Flow At Mouth	0.01	0.62	2.65	5.43	7.94	7.72	4.12	1.01	0.04	1,793
Average Flow At Mouth	545	253	88	47	37	45	65	601	1,236	176,821

Source: Douglas County Water Resources Survey, 1991.

The impact of irrigation return flows to Elk Creek are expected to be minimal. Return flows could contribute up to about 12% and 18% additional monthly flow during the late summer of a normal water year near Drain and at the mouth of Elk Creek, respectively (Table 3-8-7). Return flows could contribute an average of 2.7% and 1.0% of the yield at Drain and the mouth, respectively, during a normal year.

3.1.8.3 Mitigation of Impacts to Surface Water Quantity

The stream regulation provided by the project would favorably affect downstream uses, including those for irrigation, municipal, flood control, and industrial. The impact on fisheries resources would be beneficial by increasing the productivity of Elk Creek because of higher summer flows and lower summer water temperatures. No adverse impacts have been identified at this time that require mitigation however, Douglas County has sized the reservoir to allow up to 7,737 acre-feet of water to be stored to provide flows (in addition to project flows) and water temperature control downstream of the dam for fisheries resources. A plan for the release of the stored water would be developed between County and fish and wildlife agencies. The use of this stored water is discussed in Section 3.1.15, Fisheries Resources.

3.1.9 Surface Water Quality

3.1.9.1 Existing Water Quality

Water quality in the Elk Creek subbasin is generally good.

Water from Elk Creek and its tributaries has been used for municipal, industrial, domestic and irrigation purposes. Total dissolved solids (TDS) are well below the recommended maximum (500 mg/l), for municipal use. Most constituents, including calcium, sodium, potassium, carbonate, sulfate, and chloride are well below recommended limits (Bureau of Reclamation, 1991).

Surface water in the Elk Creek subbasin generally meets the EPA criteria for drinking water (Table 3-9-1), although high levels of coliforms have been measured at times due to the presence of treated domestic waste discharges in the Elk Creek subbasin (Table 3-9-2) and low summer flows (Department of Environmental Quality, 1990). There are about 10 residential septic systems in the reservoir pool area. These septic systems have not been reported to cause a problem.

Table 3-9-1. Mean and Maximum Concentrations of Chemical Constituents and Water Quality Criteria Elk Creek near Elkhead, Oregon (All units in mg/l except as noted).

Parameter	Elk Creek near Elkhead		Drinking Water Standard	Irrigation Criteria
	Mean	Maximum		
Conductivity (um/cm)	12	198	--	<750
pH (standard units)	7.2	7.8	>6.5	4.5-9.5
Calcium	11.6	20.0	--	--
Magnesium	2.93	4.04	--	--
Sodium	7.15	11.6	--	<69
Sodium adsorption ratio (no units)	0.5	0.6	--	<3.0
Chloride	12.9	24.6	<250	<106
Arsenic	<0.01	<0.01	<0.05	0.1
Cadmium	<0.003	0.008	<0.01	<0.01
Chromium	<0.02	<0.02	<0.05	<0.1
Copper	<0.05	<0.1	<5.0	<50
Fluoride	<0.2	0.2	1.4-2.4[1]	<1
Lead	<0.01	0.01	<0.05	<5
Mercury	<0.002	0.002	<0.002	<0.01
Selenium	<0.003	0.004	<0.01	<0.02
Zinc	0.06	0.17	<5.0	<25.0

[1] Fluoride content varies with maximum daily air temperature.

Source: Myers, 1992.

Relatively little municipal waste water is generated in the Elk Creek subbasin, because of the sparse population. The city of Drain uses land application of treated wastewater. The city stores treated wastewater in a lagoon for summer application. The city of Yoncalla stores treated waste water in a lagoon in order to comply with DEQ discharge limitations. Yoncalla's wastewater is discharged into Yoncalla Creek.

Water temperatures seasonally exceed the limits tolerable to anadromous fish. Nutrient levels become high during low-flow periods, resulting in algae growth, which in turn reduces dissolved oxygen levels. In combination, conditions reach levels that are critical for aquatic life and the appearance of the streams become aesthetically unpleasant. The most obvious characteristics of the existing water supply is the seasonal high water temperatures in summer, and excessive turbidity during the fall, winter and spring months.

Table 3-9-2. Waste discharges in Elk Creek subbasin.

LOCATION	RECEIVING STREAM	CATEGORY	WASTE TYPE
Drain Sanitary Treatment Plant	Elk Creek	Minor Domestic	Sanitary Waste
Ranch Motel	Yoncalla Creek	Minor Domestic	Sanitary Waste
Rice Hill West	Yoncalla Creek	Minor Domestic	Sanitary Waste
Yoncalla Sanitary Treatment Plant	Yoncalla Creek	Minor Domestic	Sanitary Waste
Yoncalla Water Treatment Plant	Yoncalla Creek	Minor Industrial	Filter Backwash
Wooley Enterprises	Elk Creek	Minor Industrial	Log Pond Overflow
Wooley Enterprises, Plywood Mill	Pass Creek	Minor Industrial	Log Pond Overflow
Wooley Enterprises, Highway 38	Elk Creek	Minor Industrial	Log Pond Overflow
Wooley Enterprises, Smith River	Pass Creek	Minor Industrial	Log Pond Overflow

Source: Myers, 1992.

Water quality samples were taken from Elk Creek at Elkton during the months of April through October for 1982, 1983, 1984 and early 1985 (Douglas County, 1989). Sample temperatures consistently exceed 68°F in July and August, and in June, 1982 reached 77°F. Nitrogen levels generally are low, with the maximum nitrate plus nitrite reading at .04 milligrams per liter (mg/l), well below the 0.3 mg/l EPA guideline for aquatic life. In 1982, April and October readings were 0.15 and 0.25 mg/l respectively, which could result from storm run-off. Phosphorous levels also are generally low, compared to the EPA guideline of 0.1 mg/l. Increased values have been noted, such as in late September, 1983 when the phosphorous level was 0.965 mg/l. In April and September of 1982, phosphorous levels also exceeded the guidelines. Dissolved oxygen was above 8 mg/l in all but one sample, which reached 7.9 mg/l in July, 1982 (Myers, 1989).

Color and turbidity in Elk Creek have the potential to cause some seasonal problems for municipal water use (Table 3-9-3). High color is an aesthetic problem believed to originate from deciduous leaf fall and does not make water unpotable, although filtration is necessary to reduce turbidity to permissible levels. Surface waters in Adams Creek and in Billy Creek have been used for public water supplies in Yoncalla and Drain for a number of years without chemical problems. Excessive turbidity is a seasonal event which occurs during high flows, especially after the first storm in the fall. After the initial storm events, turbidity decreases and then increases as more flood events occur throughout the year.

Table 3-9-3. Summary of color and turbidity data, Elk Creek.

	Color Units	Turbidity[1]
Elk Creek at bridge near RM 42.2		
Number of Samples	14	16
Mean	51	12
Maximum	175	45
Elk Creek near Drain		
Number of Samples		35
Mean		11
Maximum		50
Elk Creek near Elkton (DEQ)		
Number of Samples	63	35
Mean	24	19
Maximum	100	120
EPA Drinking Water Standard		
Standard	15	1

[1] Nephelometric turbidity units.
Source: Bureau of Reclamation, 1991

Douglas County has installed and maintains two gages with thermographs in the Elk Creek subbasin. One gage is near Elkhead at river mile 37.5 (since June, 1980). The other gage is near Drain at river mile 26.5, (since October, 1986). Mean monthly temperatures do not exceed 65°F at Elkhead, however maximum mean daily readings have exceeded 65°F during the May through August period. During November through March, temperatures are nearly equal at Elkhead and Drain gages (Figures 3-9-1 through 3-9-4). During March or April through September, the effects of solar heating on diminished flows become evident, and mean monthly temperatures at Drain during June through August are greater than 65°F, and the temperatures at the 2 gages diverge.

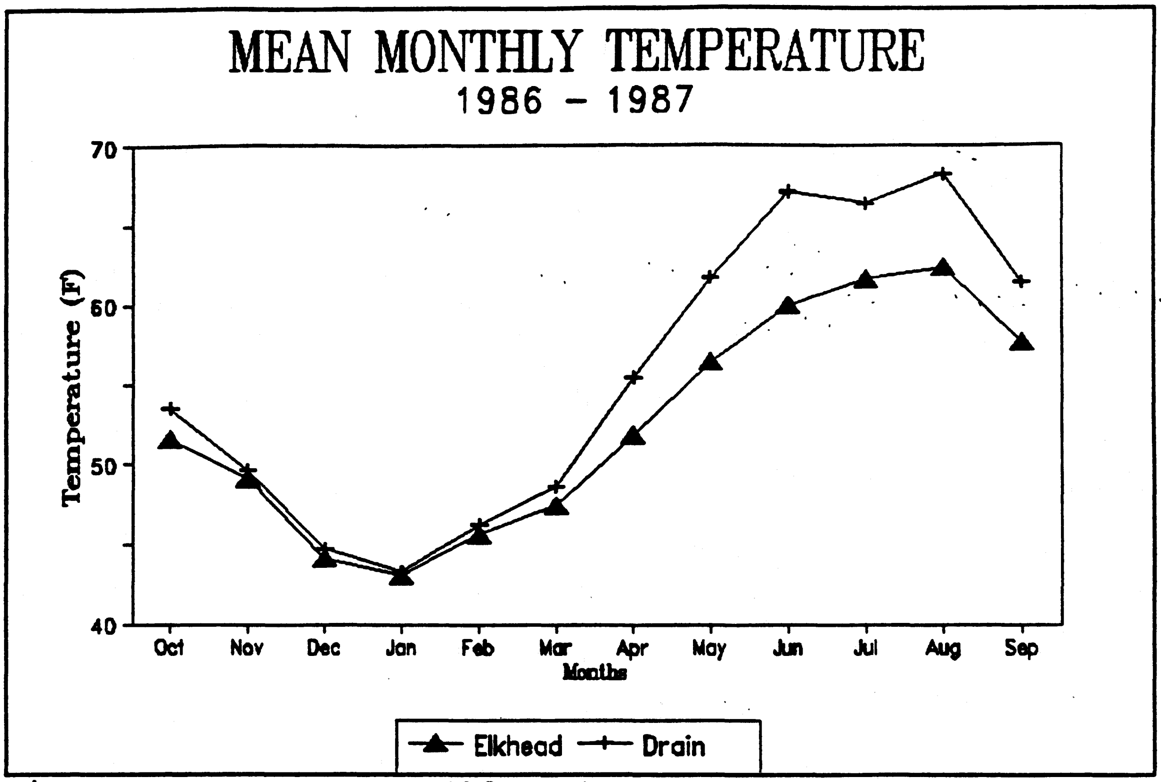


Figure 3-9-1. Mean Monthly Water Temperature, 1986-87.

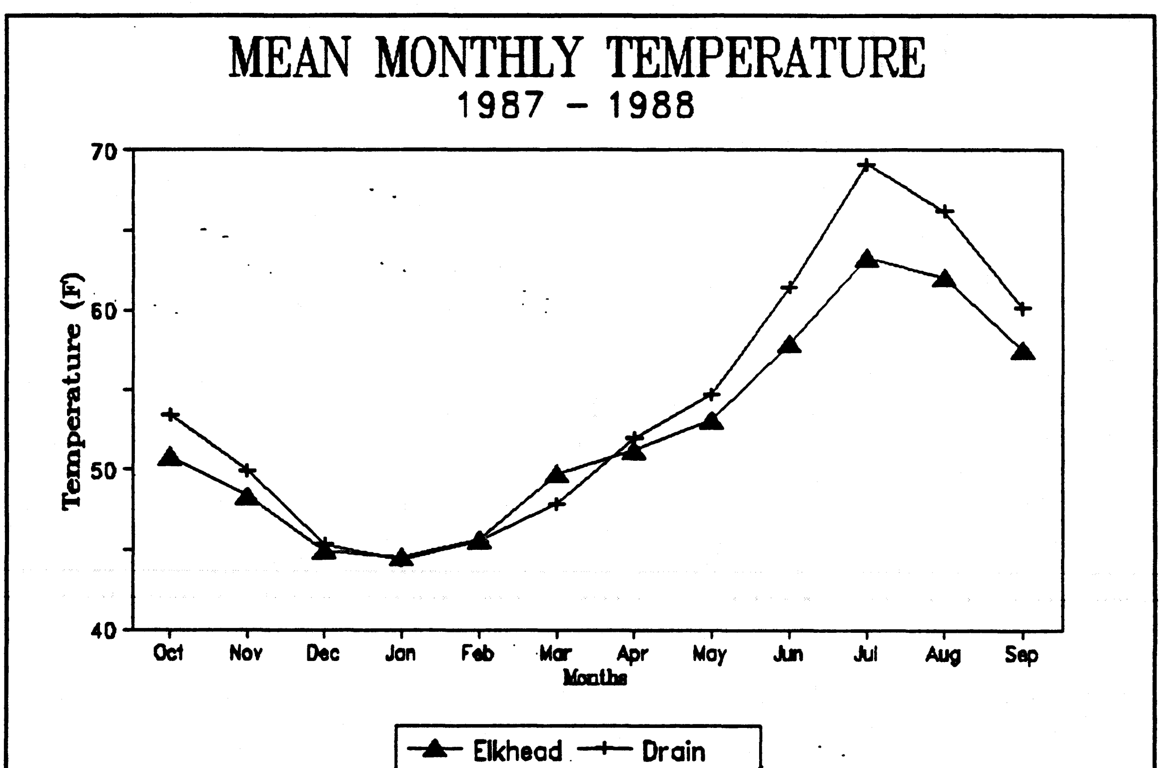


Figure 3-9-2. Mean Monthly Water Temperature, 1987-88.

F:Temp86-8

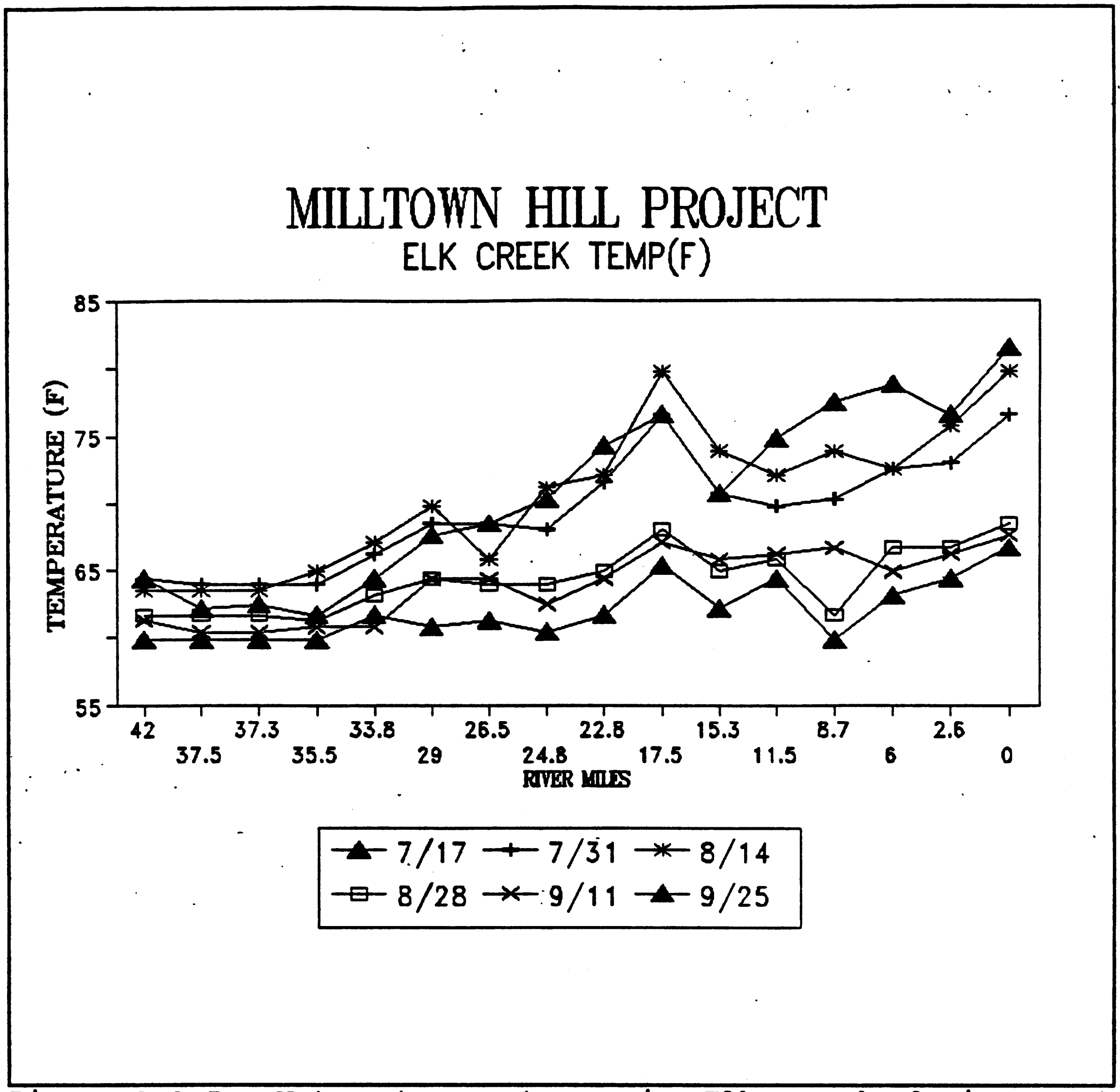


Figure 3-9-5. Water temperatures in Elk Creek during spot measurements made in 1990.

F:Milltemp

Table 3-9-4. Results of water, sediment, and fish tissue analyses for mercury from Elk Creek.

SAMPLE DATE	LOCATION	TEST TYPE	MG/L	PPM	PPB	PERFOR BY
05/29/86	BRIDGE CROSSING NEAR RM 42.2	PRIMARY DRINKING	<0.001	-	-	DCWR
11/21/86	BRIDGE CROSSING NEAR RM 42.2	WATER QUALITY	<0.001	-	-	DCWR
02/11/87	BRIDGE CROSSING NEAR RM 42.2	" "	<0.001	-	-	DCWR
05/14/87	BRIDGE CROSSING NEAR RM 42.2	" "	0.002	-	-	DCWR
08/05/87	BRIDGE CROSSING NEAR RM 42.2	" "	0.002	-	-	DCWR
11/09/87	BRIDGE CROSSING NEAR RM 42.2	" "	0.002	-	-	DCWR
08/23/88	BRIDGE CROSSING NEAR RM 42.2	" "	<0.001	-	-	DCWR
11/14/88	BRIDGE CROSSING NEAR RM 42.2	" "	<0.001	-	-	DCWR
02/27/89	BRIDGE CROSSING NEAR RM 42.2	" "	<0.001	-	-	DCWR
02/18/81	BRIDGE CROSSING NEAR RM 42.2	PRIMARY DRINKING	<0.0005	-	-	DEQ
05/12/81	BRIDGE CROSSING NEAR RM 42.2	WATER QUALITY	<0.0005	-	-	DEQ
12/30/81	BRIDGE CROSSING NEAR RM 42.2	" "	<0.0005	-	-	DEQ
08/18/82	BRIDGE CROSSING NEAR RM 42.2	" "	<0.0005	-	-	DEQ
05/29/86	#1 SPRING @ STORAGE TANK	WATER QUALITY	0.002	-	-	DCWR
05/29/86	#2 POND BELOW MERC MINE	" "	0.003	-	-	DCWR
05/29/86	#3 SEEP BELOW MERC MINE ABOVE #4	" "	0.011	-	-	DCWR
05/29/86	#4 SEEP @ ROADSIDE DITCH AND BELOW #3		<0.001	-	-	DCWR
05/29/86	#5 ELK CREEK @ ELKHEAD RD BRIDGE	" "	<0.001	-	-	DCWR
08/89	UNNAMED TRIB NEAR MERC MINE ON RD#8 .25MI FROM RD#7	SEDIMENT ANALYSIS	-	11A	2.3B	DCWR
08/89	UNNAMED TRIB NEAR MERC MINE ON RD#8 .25MI FROM RD#7	SEDIMENT ANALYSIS	-	25A	1.7B	DCWR
08/89	ELK CREEK, RD #7,BR#7,8.45,N.B. 10'D.S.	SEDIMENT ANALYSIS	-	14A	.65B	DCWR
08/89	ELK CREEK, RD #7,BR#7,8.45,N.B. 10'D.S.	SEDIMENT ANALYSIS	-	1.5A	.65B	DCWR
08/89	ELK CREEK DAM FOUNDATION 50'U.S.,AXIS B, LEFT BANK	SEDIMENT ANALYSIS	-	.60A	.65B	DCWR
08/89	ELK CREEK DAM FOUNDATION 50'U.S.,AXIS B, LEFT BANK	SEDIMENT ANALYSIS	-	.26A	.65B	DCWR
10/03/88	RM 17.25	WATER QUALITY	<0.001	-	-	DCWR
10/03/88	RM 17.75	" "	<0.001	-	-	DCWR
10/03/88	RM 32	" "	<0.001	-	-	DCWR
10/03/88	RM 33	" "	<0.001	-	-	DCWR
10/03/88	RM 35.5	" "	<0.001	-	-	DCWR
10/03/88	RM 36	" "	<0.001	-	-	DCWR
09/13/88	ELK CR NEAR DRAIN MP 8.2	" "	ND@0.001	-	-	DCWR
12/27/89	ELK CR /BR STREAM MILE 8.2	" "	0.001	-	-	DCWR
07/02/87	BELOW MERC MINE ABOUT 6 MILES	FISH TISSUE	-	-	16C	DCWR
07/02/87	ABOVE MERC MINE ABOUT 1 MILE	FISH TISSUE	-	-	3C	DCWR
07/02/87	BELOW MERC MINE ABOUT 1 MILE	FISH TISSUE	-	-	ND@1C	DCWR

ND = NONE DETECTED AT LEVEL INDICATED

DCWR = DOUGLAS COUNTY WATER RESOURCES; DEQ = DEPARTMENT OF ENVIRONMENTAL QUALITY

A = VALUES REPRESENT TOTAL MERCURY CONCENTRATIONS OBTAINED FROM 1:5 SOIL EXTRACTS; SOIL EXTRACTS FILTERED THROUGH 0.45 AND 0.10 FILTERS, FILTERED SAMPLES ACIDIFIED AND PRESERVATIVES ADDED.

B = VALUES REPRESENT TOTAL MERCURY CONCENTRATIONS OBTAINED FROM TOTAL DIGESTION OF SOIL SAMPLES.

C = REPORTED AT PPB.

OREGON ADMINISTRATIVE RULES
CHAPTER 340, DIVISION 41 - DEPARTMENT OF ENVIRONMENTAL QUALITY

MERCURY - CONCENTRATION IN MICROGRAMS PER LITER FOR PROTECTION OF AQUATIC LIFE, FRESH ACUTE CRITERIA = 2.4, FRESH CHRONIC = 0.012.

CONCENTRATION IN UNITS PER LITER FOR PROTECTION OF HUMAN HEALTH, WATER AND FISH INGESTION = 144 ng., DRINKING WATER M.C.I. = 0.002 mg.

F:MERC

Elk Creek	-	River Mile	37.5
Elk Creek	-	River Mile	36.3
Elk Creek	-	River Mile	35.5
Adams Creek	-	River Mile	0.5
Halo Creek	-	River Mile	3.5
Cowan Creek	-	River Mile	0.5
Yoncalla Creek	-	River Mile	2.0
Yoncalla Creek	-	River Mile	3.3
Yoncalla Creek	-	River Mile	4.0
Yoncalla Creek	-	River Mile	5.3
Yoncalla Creek	-	River Mile	6.9
Yoncalla Creek	-	River Mile	9.0
Unnamed Creek	-	River Mile	0.5
Unnamed Creek	-	River Mile	1.3
Huntington Creek	-	River Mile	0.5

A typical stream crossing by the pipeline would involve the construction of a trench and the placement of the pipe below the level of the streambed. The trench would then be backfilled with rock to prevent scouring of the trench during high flow periods. Due to the proximity of the trench to the bridge crossing, minimal disturbance of vegetation is anticipated, and significant impact to water quality likely would not occur.

3.1.9.2.2 Operation

When in operation, water quality would improve, primarily due to special dam releases made for fishery purposes and for irrigation along Elk Creek. Return flows would not have harmful effects on the surface water quality because of complete sprinkler irrigation. Up to 85 percent of irrigated lands would be in irrigated pasture, with cattle and sheep production. This would limit the use of harmful pesticides and herbicides on irrigated crop lands.

Surface water supplies are expected to be low in dissolved solids, and would have a very low sodium hazard and very low in boron concentration. In general, surface water supplies are ideal for irrigation.

The same is true for industrial purposes; however, surface water supplies would require treatment before being used for domestic purposes. Treatment would consist of chlorination, and probably turbidity control during periods of extreme runoff into the reservoir.

The operation of the project would result in storage of water that would be released to meet downstream demands including those for fisheries resources. Water quality in the reservoir is expected to be excellent because of the location of the dam in the upper reaches of Elk Creek where basin degradation has been relatively low. The early years of operation of the project would result in minor increased erosional runoff from the areas where construction activities occurred. During winter, storm runoff would increase turbidity and sedimentation in the reservoir, some of which may pass through the reservoir, however, the presence of the "dead pool" (500 acre-feet) in the reservoir is estimated to be sufficient to trap some sediments for 100 years.

The reservoir would have water depths up to about 186 feet at full pool near the dam. Reservoir stratification is expected to result in reduced levels of dissolved oxygen in the lower levels (hypolimnion) which could be released to the stream. However, use of the fixed cone valve should adequately oxygenate reservoir release.

Filter-feeding aquatic invertebrates and their populations would be expected to increase for some distance below the dam. This beneficial effect to fisheries resources would occur because of increased food materials in the release waters from phytoplankton or zooplankton production in the reservoir.

Operation of the dam would result in increased releases of water during summer months. Water temperature modelling of the reservoir releases for several years is shown in Figure 3-9-6. Temperatures of release waters are predicted to be between 40° and 55°F, depending on water year. For 1977, temperature was near 65°F in September due to a low reservoir. Temperatures of release water are up to 20°F lower than natural stream temperatures (Figure 3-9-5).

The effect of the release of cooler water on downstream water temperatures was evaluated by using a stream temperature model (SSTEMP model developed by the USFWS) to predict change in water temperatures between the dam and Elkton. Input parameters, except for flow, characteristic of each month were obtained from Oregon State University, Department of Atmospheric Sciences. The area was divided into 2 segments. Segment 1 was between the dam (RM 39.4) and Drain (RM 26.5) and Segment 2 was between Drain and Elk (RM 0). The differences in the 2 segments were amount of shade and stream width. Model input temperatures at river mile 39.4 (dam) were water temperatures determined with the reservoir model. The output temperature for segment 1 was the input temperature for segment 2. The model was run every 15 days between June 1 and September 15.

The reservoir release temperatures were similar for all years modelled except for the high temperature in September 1977, when temperatures were near 63°F. The average release temperature for the period modelled was used as the input temperature to the stream model except for September. For September, 2 model runs were made with a high temperature of 63°F for 1977 and the average for the other years (52°F).

All terrestrial wildlife use of the reservoir inundation areas and the road relocation areas would be lost, while the quarry would be reclaimed and provide some wildlife use. The recreation sites would continue to provide wildlife use, but at reduced acreages and values.

The HEP demonstrated impacts to wildlife in terms of changes to the AAHU's. These changes are determined by comparing future without-the-project conditions against future with-the-project. The reduction of AAHU's are the product of the reduction of acres of terrestrial vegetation cover-types and a partial degradation of certain habitat values, as expressed in habitat suitability indices (HSI). The HEP study also recognized the gained habitat values that would be associated with the upper reservoir's aquatic environment as indicated by increases in AAHU's for osprey and western pond turtle. Changes in AAHU's with the project for each of the evaluation species are summarized in Table 3-14-3 (Fish and Wildlife Service, 1990).

Table 3-14-3. Net Changes in Average Annual Habitat Units (AAHU's) for the Milltown Hill Project.

Species	AAHU's Without Project	AAHU's With Project	Net Change
Downy Woodpecker	349	190	-159
Western meadowlark	252	90	-162
Yellow warbler	109	10	-99
Wild turkey	584	290	-294
Black-tailed deer	1,005	510	-495
Osprey	0	214	+214
Western pond turtle	8	64	+56

Changes assume both direct losses with the reservoir and indirect losses with road relocation, borrow sites, and recreation developments. Also assumes timber retention in portions of the reservoir and wetlands development at the upper end of the reservoir.

Source: Fish and Wildlife Service, 1990.

3.1.14.3 Mitigation of Impacts to Wildlife

Those areas temporarily disturbed by construction activities would be recontoured and revegetated after construction to hasten rehabilitation of the habitat. Native vegetation would be used to the extent possible (Fish and Wildlife Service, 1990).

The loss of 173 acres of riparian vegetation by reservoir inundation, would be mitigated by habitat enhancement on portions of Elk Creek downstream of the project site. Restoration could include plantings and/or fencing in areas where vegetation has been impacted by grazing, brush clearing, and other human activities. The County would develop a riparian program to identify problem

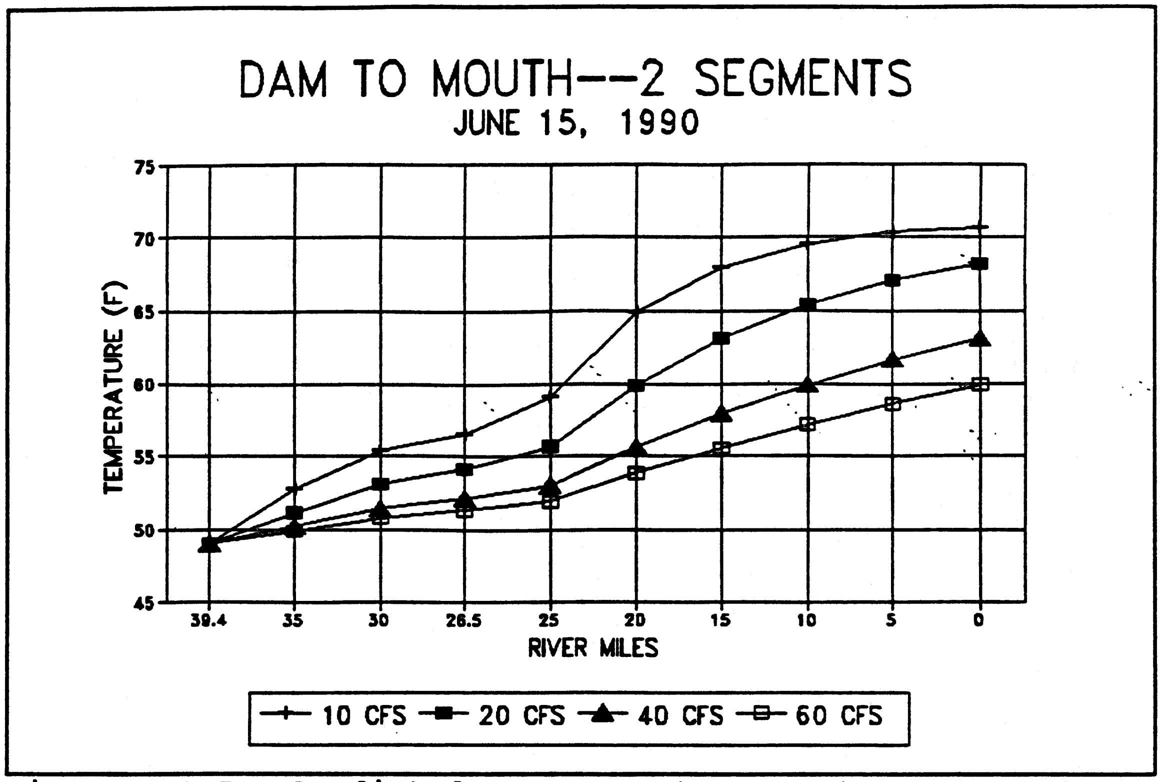


Figure 3-9-7. Predicted Average Stream Water Temperatures for June 15.

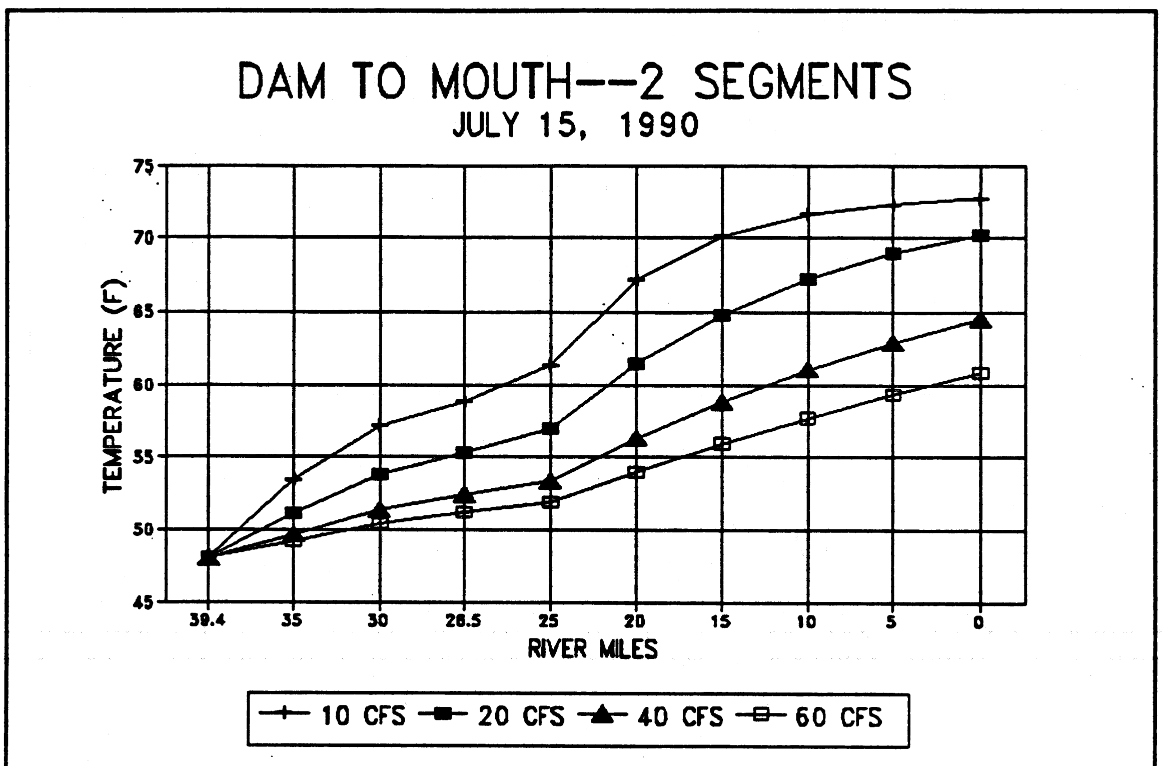


Figure 3-9-8. Predicted Average Stream Water Temperatures for July 15.

reservoir. Sodding, erosion mats, riprap, bale dikes, flumes or other appropriate measures would be used where erosion might occur.

To minimize erosion from the haul road, the contractor would be required to install silt curtains the length of the west side of the road. In addition, sediment settling ponds would be required in selected drainages where erosion could be significant. These drainages would be identified and measures implemented prior to construction.

The settling ponds for aggregate processing and cleaning would comply with State and Federal water quality standards that define a mixing zone. Recycling of water in these ponds would be implemented to reduce flow from the settling ponds to Elk Creek.

The existing septic tanks in the pool area would be pumped, filled with sand, and sealed as buildings are abandoned.

Dewatering work for structure foundations or earthwork operations adjacent to, or encroaching on, streams or watercourses would be conducted in a manner to prevent muddy water and eroded materials from entering the streams or watercourses by construction of intercepting ditches, bypass channels, barriers, settling ponds, or by other approved means. Excavated materials or other construction materials would be stockpiled or deposited away from streambanks and wetlands to prevent them from being washed away by high water or storm runoff.

The potential for adverse impacts due to oil and fuel spills would be reduced through care in handling these substances. Further, specific equipment repair and fuel storage areas would be selected away from Elk Creek.

Efforts to minimize impacts to water quality during operation of the project include utilization of multilevel outlets, removal of organic debris in the reservoir, minimization of soil disturbance in the reservoir, use of an aeration valve (fixed cone valve). A multilevel outlet system is planned for the reservoir to control potential water quality impacts below the dam. The multilevel outlet would be operated to optimize temperatures of release flows for anadromous fish during summer months. The release temperature would be regulated as much as possible to meet goals developed by Douglas County and the Oregon Department of Fish and Wildlife to maximize fish production in Elk Creek (See: Section 3.1.15, Fisheries Resources). In addition to temperature measurements at the dam, a control point would be established between the damsite and Drain to monitor downstream water quality conditions.

Potential impacts due to low dissolved oxygen concentrations in the reservoir would be minimized by removing as much organic debris from the reservoir subbasin before it is filled. An exception would be the debris piles left in the reservoir area for fish enhancement (See: Section 3.1.15, Fisheries Resources). An effort would be made during this clearing process to minimize soil disturbances by leaving tree stumps in place. Low dissolved oxygen concentration releases from the reservoir would be minimized by an aeration-type control valve installed in the outlet works.

A ramping rate would be established to minimize rapid increases in water level below the dam that might increase erosion. The rate would be established after review by ODFW, USFWS, and NMFS.

Water quality impacts at pipeline stream crossings would be minimized by construction during low (<5cfs) or no flow months. Most of the streams are intermittent during the summer with the exception of Adams Creek and Elk Creek. Flows in these creeks typically decrease to less than 5 cfs during summer months. Streambanks would be restored as nearly as possible to their original condition, seeded with native grasses, and protected from erosion. The additional water released during the summer months would dilute the concentrations of pollutants in domestic and industrial discharges from Yoncalla, Drain, and Rice Hill to subbasin streams (See: Table 3-9-2, Waste Discharges in Elk Creek Subbasin).

All water deliveries for irrigation would be metered. An incremental rate structure would help prevent significant agricultural runoff and the potential for adding agricultural chemicals to the surface water supply. Surface runoff would be negligible during irrigation season and would be diluted by increased stream flows during summer months. Water quality monitoring would be implemented by Douglas County for the reservoir inflows and outflows to establish levels of various nutrients (nitrates and phosphates), mercury, water temperature, pH, and dissolved oxygen.

In the unlikely event that the Elkhead mine is reopened, measures would be required of the mine operator to ensure that contamination of the reservoir does not occur as a result of mine operation. Stringent measures to regulate siting of tailings areas and waste streams would be enforced to comply with applicable local, State and Federal regulations. Erosion of the tailings area runoff would be monitored. If considered necessary, a diversion ditch would be constructed to carry any drainage water away from the tailing area to minimize erosion.

Water quality monitoring required to assure that applicable State and Federal water quality standards are met during construction would be done by the contractor and monitored by Douglas County. Water quality monitoring during operation would be conducted by Douglas County.

3.1.10 Ground Water

3.1.10.1 Existing Ground Water Conditions

Groundwater resources in the Elk Creek subbasin are limited. The majority of the underlying bedrock units consist of Jurassic and Cretaceous age altered sedimentary and volcanic rocks which have low permeability. Water storage in these units is generally in fractures, joints and bedding planes (Bureau of Reclamation, 1991).

The major portion of the rainfall in this subbasin falls on these relatively impermeable bedrock units. Greater than 90 percent of the rainfall is lost in runoff to the seasonal streams with very little recharge to the ground-water system because of the low permeability of the bedrock units (Bureau of Reclamation, 1991). As a result of this, adequate groundwater storage for natural stream regulation does not occur.

In 1977, the U.S. Geological Survey prepared a water resources investigation map for a portion of Douglas County (Robinson and Collins, 1977). The following is taken from this report:

> "Depth to water in wells in the project area ranges from slightly below land surface to as deep as 256 feet. In most places, the depth to water is less than one contour interval of land-surface altitude (80 feet). Thus a map of the altitude of the water table would be a virtual facsimile of the topographic base. Water tends to move in response to differences in water levels, but permeability, and therefore water movement in the reported area is usually greatest parallel to bedding planes in a formation, which are seldom horizontal. Water levels of wells that are unaffected by pumping fluctuate seasonally about 4 to 6 feet, the highest levels occurring during the rainy season, in winter or early spring."

> "Alluvium floors the larger valleys, such as those formed by Pass, Yoncalla and Elk Creeks. Alluvium in these creeks are generally thin. In the Drain-Yoncalla area there is little, if any, saturated permeable alluvium at depths greater than 18 feet. The oldest rock exposed in the Drain-Yoncalla area is the Umpqua Formation, which has been subdivided into a lower basalt member and upper sedimentary member consisting of sandstone and siltstone. Wells in the sedimentary rocks yield less than 10 gal/min. Well yields vary widely in the basalt member, the maximum yield reported is 40 gal/min."

3.1.10.2 Ground Water Impacts

3.1.10.2.1 Construction

The construction of a reservoir generally alters the ground-water regime in response to changing the local water conditions where the water is impounded. The local water table will usually rise to the elevation of the new water reservoir. Because the permeability of the bedrock units is low, this change may occur over a long period of time. The increase in water levels may affect the stability of the wetted slopes facing the reservoir. The quality and quantity of ground water is not expected to significantly change with the construction of the dam.

3.1.10.2.2 Operation

Areas of slope instability in the reservoir zone could be affected by a rise in ground water. Additional stresses imposed by the rise in water levels could reactivate old landslides and could temporarily affect reservoir water quality.

The effect of increased irrigation on ground water was considered. Sprinkler irrigation methods, properly timed, conserve water and minimize leaching. Consequently, only small amounts of water are expected to reach existing ground water levels through the typically fine- to medium-grained soils. Nutrients, salts, and agricultural chemicals would undoubtedly be carried downward from the surface into the upper soil zone. It is unlikely, however, they would reach the ground water in high concentrations due to physical and chemical filtration processes in the upper soil.

The irrigation return flows to Elk Creek are not considered crucial to maintenance of flows in Elk Creek. The return flows would contribute a small proportion to meeting instream needs for flows, such as for fisheries resources. Also, the relatively small amount of irrigation return flow would not exceed the hydraulic capacity of Elk Creek (<u>See</u>: Section 3.1.8, Water Quantity).

Operation of properly installed subsurface drainage systems during the irrigation season, and during the non-irrigation season should result in improved ground water quality. The systems would provide an improved means of movement of water through the soil, thereby dispersing and equalizing soil nutrients found in the water. Return flows would not have harmful effects on ground water quality or Elk Creek. Project water supplies are expected to be low in dissolved solids, have a very low sodium hazard, and very low boron concentration. In general, project surface water supplies are ideal for irrigation (Hill, 1971).

3.1.10.3 Mitigation of Ground Water Impacts

Areas of slope instability in the reservoir area would be identified by additional field work in the design phase. Problem areas identified would be stabilized or protected to prevent mass soil movement into the pool.

Minor adverse impacts to ground water quality during construction of a subsurface drainage system, if needed, would be lessened by limiting construction activities to the late summer months, when ground water and surface water flows are low.

Impacts during operation would be mitigated by the low amounts of return flow and the releases from the project for instream flows which would dilute return flows. Return flows would be diluted by at least 5 to 1 when return flows are highest during an average year.

3.1.11 Vegetation

3.1.11.1 Existing Vegetation

3.1.11.1.1 Uplands

Interior valley vegetation, mixed evergreen forests, and mixed coniferous forests, as defined by Franklin and Dyrness (1973) form the major vegetation zones in the Elk Creek subbasin. Elk Creek supports a relatively narrow zone of riparian vegetation. Extensive human activities (e.g., clearing, logging, grazing, and agriculture) have created a patchwork of altered vegetative types throughout the project area (Fish and Wildlife Service, 1990).

Interior valley vegetation predominates the valley bottoms surrounding lower Elk Creek below Drain. This area is an interspersion of pastures and oak woodlands. The woodlands are composed of Oregon white oak and to a lesser extent black oak, with understory shrubs such as poison oak, scotch broom, elderberry, western hazel, trailing blackberry, and wild rose. Pasturelands are a mixture of introduced and native grasses and annuals. Many pastures have been seeded with species such as rye grass and subclover (Fish and Wildlife Service, 1990).

The mixed-evergreen zone has an overstory of Douglas-fir, western redcedar, and Pacific madrone, with an understory of tanbark oak, Oregon white oak, chinquapin, and various oak species. The shrub layer is often well developed and includes species such as manzanita, Oregon grape, poison oak, and trailing blackberry.

The mixed-conifer zone occurs at the higher elevations and on the wetter, cooler canyon slopes. Overstory trees include Douglas-fir, western redcedar, and grand fir. Bigleaf maple and Pacific madrone occur sporadically throughout this zone. Understory plants include salal, ocean spray, black hawthorn, sword fern, and bracken fern. This zone has undergone extensive logging and is mostly second-growth, with small patches of mature timber remaining on public lands and in the more inaccessible areas of private land. General vegetation types within the project take-line are shown in Figure 3-11-1.

3.1.11.1.2 Riparian and Wetlands

Elk Creek supports a narrow riparian zone usually on both sides of the stream channel. Dominant species include black cottonwood, red alder, white alder, Oregon ash and various willow species. Understory vegetation varies from dense thickets to openings of low herbaceous species. The riparian habitat within the reservoir pool area and immediately downstream is in fairly good condition. Further downstream, adjacent to the agricultural area, grazing, homesite development, firewood cutting, and other human disturbances have degraded riparian habitat (Fish and Wildlife Service, 1990).

Most of the agricultural areas have been subjected to some drainage. Grazing or haying activities have altered much of the wetland characteristics. Flat areas in the valley bottoms with saturated hydric soils have some Juncus, Carex, and course grasses tolerant to flooding. The Soil Conservation Service (SCS) has mapped soils in the project area as part of its broader responsibility for identifying agricultural wetlands. Preliminary mapping has tentatively identified about 1,765 acres of hydric soils in the areas proposed for irrigation upstream of Drain, exclusive of the reservoir pool area.

The USFWS National Wetlands Inventory show wetlands areas primarily along riparian corridors of Elk Creek and Yoncalla Creek. The Bureau of Reclamation and FWS identified 225 acres of wetlands in the agricultural service areas where seasonally saturated conditions, hydric soils, and emergent hydrophytic vegetation exist (Bureau of Reclamation, 1991). Further studies by Douglas County in March 1991 identified approximately 203 total acres with wetland hydrology, hydric soils, and emergent aquatic vegetation closely corresponding to the earlier wetland acreage. Of the 203 wetlands acres, 72 are found in Scott's Valley, 102 are in Yoncalla Valley and 28 are in the lower reach of Elk Creek, west of Drain (Figures 3-11-2 and 3-11-3). An additional 31 acres of hydrophytic vegetation and seasonally saturated conditions were identified in the reservoir area. Project wetlands were categorized into "Natural Condition" wetlands and "Manipulated Pasture" wetlands and identified as follows:

TOWNSHIP 23 SOUTH, RANGE 4 WEST

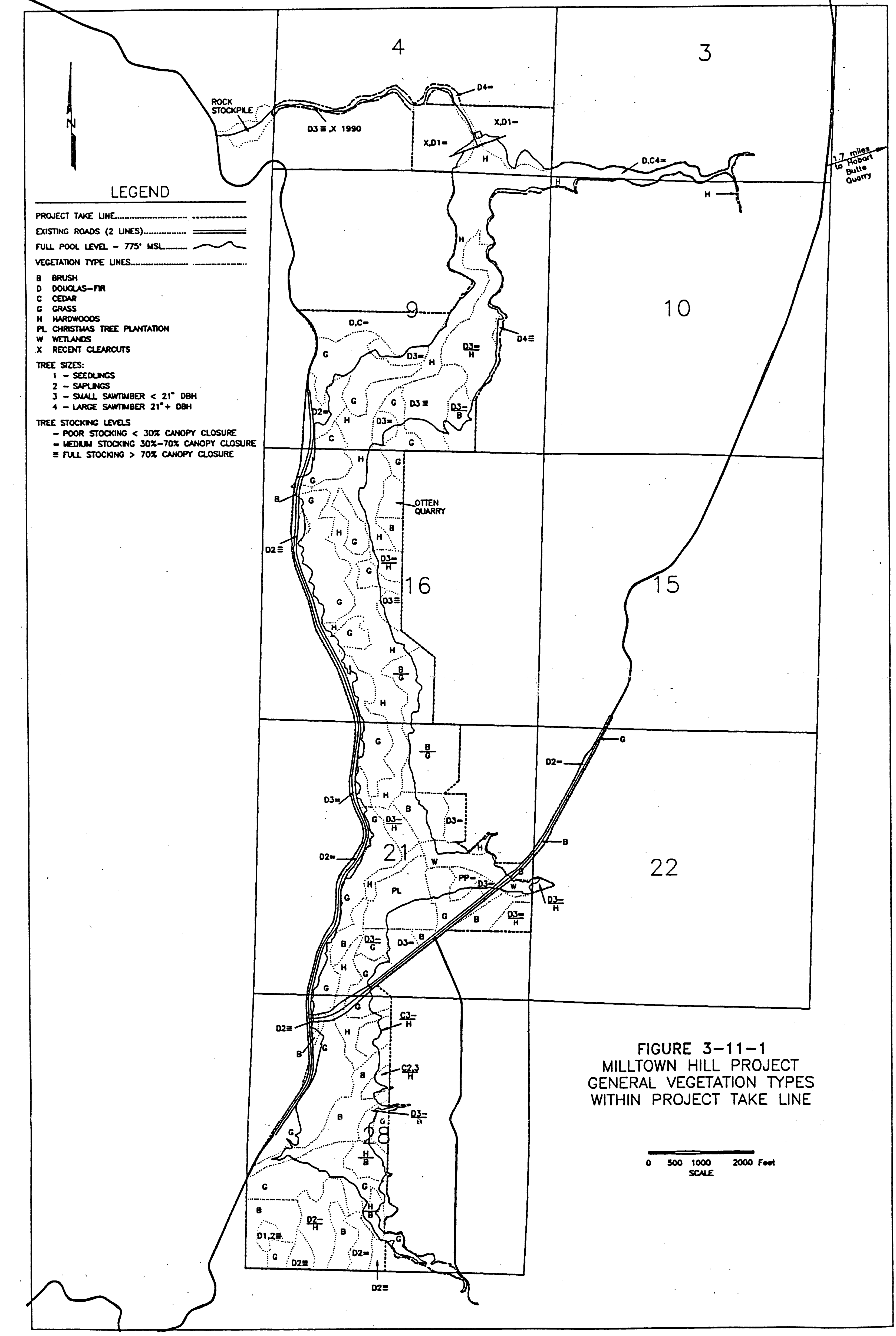
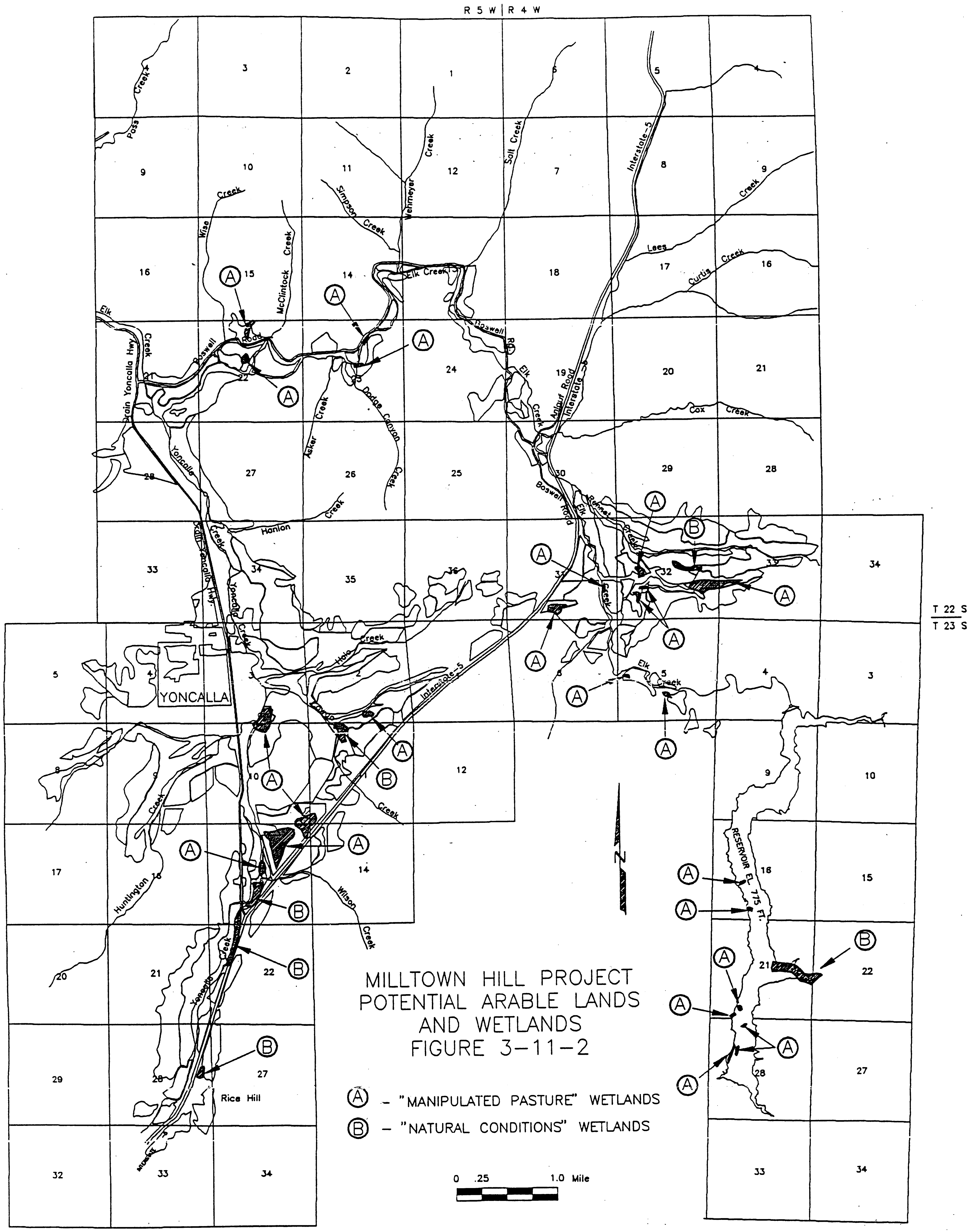


FIGURE 3-11-1
MILLTOWN HILL PROJECT
GENERAL VEGETATION TYPES
WITHIN PROJECT TAKE LINE



MILLTOWN HILL PROJECT
POTENTIAL ARABLE LANDS
AND WETLANDS
FIGURE 3-11-2